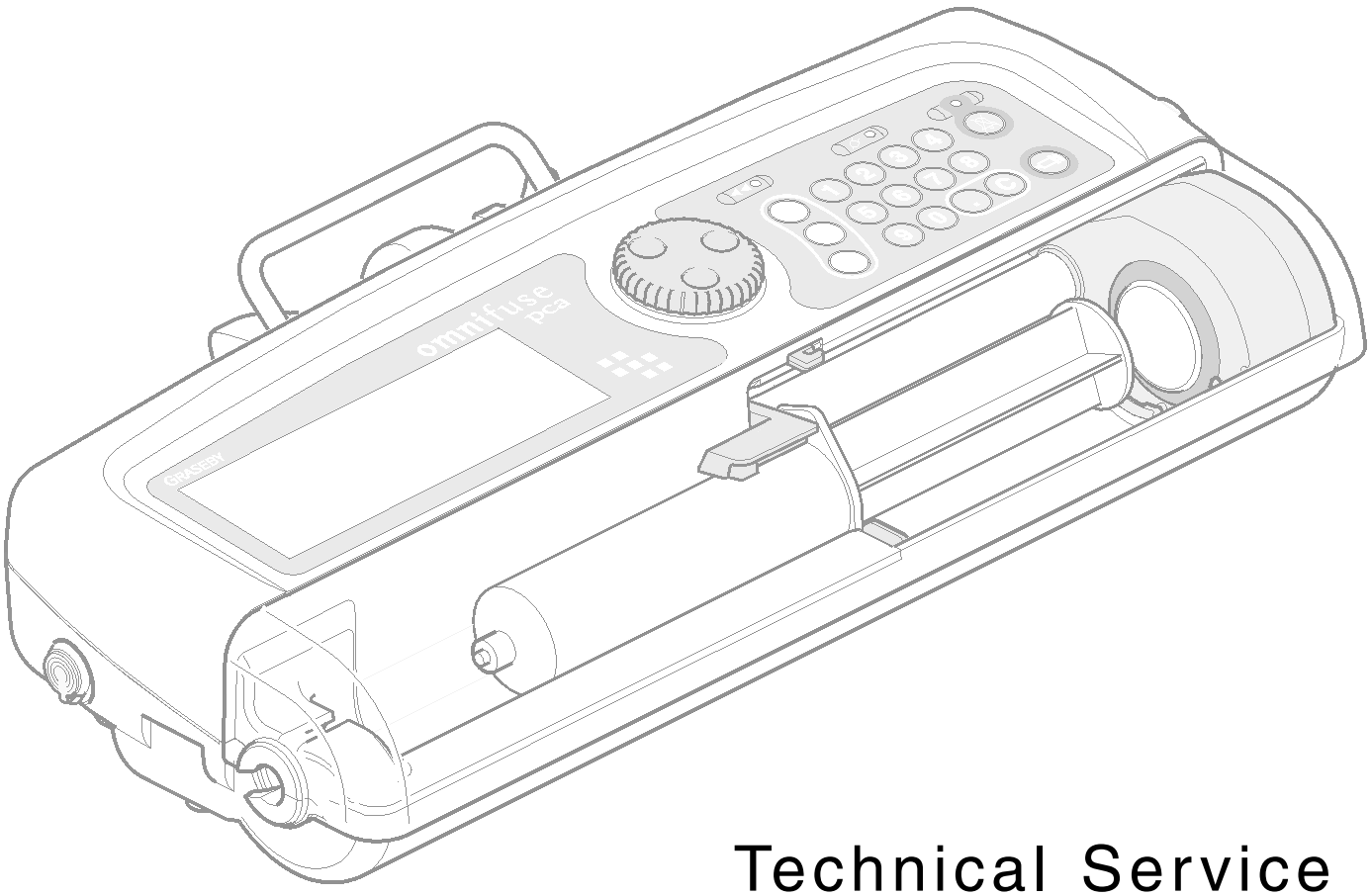
smiths

omnifuse™

Syringe Pump

PCA Pump



* PCA version shown

Technical Service **Manual**

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Warnings and Cautions

The following warnings and cautions appear in this manual.

Warnings

Warnings tell you about dangerous conditions (i.e. those capable of causing death or serious injury to the user or patient) that can occur if the instructions in this manual are not obeyed.

1. **WARNING: To avoid over- or under- infusion, always verify that the brand and size of the loaded syringe are the same as the brand and size displayed on the screen before starting an infusion. Failure to do so may result in an inaccurate delivery of medication, resulting in patient injury or death.**
2. **WARNING: To avoid incorrect or inappropriate configuration of the pump, the Configuration menu must only be selected by qualified persons or authorised personnel. Incorrect pump configuration could lead to inappropriate infusion resulting in patient injury or death.**
3. **WARNING: This equipment is not suitable for use in the presence of flammable anaesthetics, oxygen-enriched or explosive atmospheres. The use of the device in such atmospheres may lead to explosion or fire.**
4. **WARNING: To avoid possible malfunction of the pump, do *not* expose the pump to X-rays, gamma rays or ionizing radiation, or to the RF interference or strong electric/magnetic fields emitted (for example) by diathermy equipment or mobile telephones. If the pump is used in the presence of, or in combination with Magnetic Resonance Imaging (MRI) machines it must be protected from the magnetic field emitted by such equipment. Malfunction of the pump can cause incorrect infusion or loss of infusion resulting in patient injury or death.**
5. **WARNING: Operation of the pump outside the temperature limits defined in the specification may result in erroneous operation. Ensure that the temperature is within the specified limits. Failure to do so may result in patient injury or user injury.**
6. **WARNING: In order to ensure that the intended infusion is performed, data must be entered correctly. Likewise before confirming any displayed data the user should ensure that it is correct. Failure to do so may result in compromised function of the product, patient injury or user injury.**
7. **WARNING: Failure to respond promptly to an alarm may result in patient injury or death.**
8. **WARNING: Failure to follow the *Service Manual's* maintenance schedule recommendations may result in compromised function of the product and lead to patient injury or death.**
9. **WARNING: It is essential that clinical staff remain within visual and audible range of the pump so that critical alarms can be seen or heard and responded to.**
10. **WARNING: The user should ensure that the performance offered by the pump is fit for the intended purpose. Failure to do so may result in compromised function of the product, patient injury or user injury.**
11. **WARNING: When the pump is carrying out an infusion, to ensure that electrical safety is maintained only items of equipment that conform to EN60950 are to be connected to the RS232 connector situated at the base of the pump, otherwise patient safety may be compromised.**
12. **WARNING: Smiths Medical MD, Inc. have taken all reasonable steps to ensure that the pump operates correctly while under remote control. It is the responsibility of the person who designs and implements the controlling device to ensure that the resulting system (pump and controlling device) is fit for its intended purpose. Failure to do so may result in compromised function of the product, patient injury or user injury.**

13. **WARNING: Do not use a faulty pump. If the pump detects a fault when it is first turned on, or if it develops a fault during operation, a continuous system alarm will sound. The LCD screen will also display a message explaining what has happened and stating that the pump must be referred to a suitably qualified engineer or returned to Smiths Medical to have the fault rectified. In this event, switch the pump off at once and disconnect it from the mains.**

14. **WARNING: Failure to use the mains lead supplied with the pump will compromise the pump's ability to resist fluid ingress, resulting in possible user or patient injury or death.**

15. **WARNING: Failure to use the mains lead retainer means that the pump may be accidentally or erroneously disconnected from the mains. Although there is battery backup in case this happens, the battery may not be sufficiently charged. Consequently there is a risk of the pump not functioning, which could lead to patient injury or death.**

16. **WARNING: Correct management of battery charging is essential to ensure that the pump can operate on batteries for the time specified. Failure to do so may lead to impaired functioning of the pump, resulting in patient injury or death.**

17. **WARNING: The occlusion alarm level must be checked before starting an infusion to ensure that it is appropriate for that infusion. Failure to do so may result in an unacceptably slow time to occlusion alarm, resulting in patient injury or death.**

18. **WARNING: If an occlusion alarm occurs, immediately clamp the line to eliminate the possibility of a bolus being delivered to the patient. Inspect the fluid pathway for kinks, clogged catheter, etc. to remove any occlusion before restarting the infusion. An unintentional bolus of medication can result in patient injury or death.**

19. **WARNING: Use only the syringes and administration sets listed in the *Specifications and Standards* section of this manual. Failure to do so may result in an inaccurate delivery. Smiths Medical does not guarantee performance of the pump if syringes other than those listed are used. Incorrect function or performance of the pump can cause complications resulting in patient injury or death.**

20. **WARNING: When using the In-Line Occlusion Sensing option, use only a Smiths Medical MD, Inc. or Smiths Medical-approved extension set (*part number 0130-0041*). Smiths Medical Ltd. does not guarantee performance of the pump if unapproved extension sets are used. Failure to observe this warning may lead to compromised performance of the pump, resulting in patient injury or death.**

21. **WARNING: The volume of fluid contained in the connecting tubing is a residual amount and will *not* be infused. Hence this extra volume of fluid must be allowed for when initially filling the syringe and purging the system. Under-delivery of medication can cause complications resulting in patient injury or death.**

22. **WARNING: To avoid patient embolism, ensure that the patient tubing is purged of all air bubbles before administering any medication. The pump provides a purge facility to assist with this process. The presence of air within the medication can result in complications leading to patient injury or death.**

23. **WARNING: Users should bear in mind that the syringe-ear clamp is for location only and may not be powerful enough to hold the syringe in place against the powerful negative back-pressures that may be encountered in certain clinical applications.**

24. **WARNING: For safe operation of the pump the syringe must be correctly loaded. Ensure that the plunger of the syringe is properly aligned with the middle of the pusher (first-touch sensor) before closing the barrel clamp to start the load process. Failure to do so may result in inaccurate delivery, resulting in patient injury or death.**

25. **WARNING: The user should ensure that their fingers are not in the path of the pusher during syringe loading or unloading. Failure to do so may result in patient or user finger injury.**

26. **WARNING: To avoid syphoning of the syringe contents (free flow), ensure that the syringe is correctly loaded into the pump, that the syringe plunger is properly engaged by the pump's pusher block and that the pump is placed not more than 80cm above the infusion site. Syphoning can result in over-infusion leading to patient injury or death.**

27. **WARNING: If you program an infusion to run at less than 0.5ml/h, there may be a significant delay between pressing the Start key and the start of fluid delivery. To reduce the startup time of an infusion, always use the purge facility to prime the line before connecting it to the patient and pressing the Start key.**

28. **WARNING: To avoid over-infusion, do not purge the infusion line when the administration set is connected to the patient. Over-infusion of medication can result in patient injury or death.**

29. **WARNING: Where the bolus function is not required, this function should be disabled to prevent inappropriate use. Failure to observe this precaution may result in patient injury or death.**

30. **WARNING: To avoid the pump becoming detached from an IV pole, always make sure that the pump is securely fixed to the pole. Always check the security and stability of the assembly with the pump mounted.**

31. **WARNING : If no IV pole is used, make sure that the pump is completely stable on a horizontal surface. Failure to observe this warning may cause damage to the Omnifuse™ syringe pump and harm the operator or the patient. As a result, the operator or patient may suffer direct injury, or the Omnifuse™ syringe pump may fail to operate correctly, leading to patient injury or death.**

32. **WARNING: Following a significant liquid spill onto the pump, it should be wiped dry and inspected by service personnel before being returned to service. Failure to do so may result in compromised functioning of the pump, leading to patient or user injury or death.**

33. **WARNING: When the Omnifuse™ syringe pump is fitted with a lockable cover, the cover and associated security software should always be used in accordance with local protocol.**
    The lockable cover protects the syringe and its contents from tampering; the security software ensures that the infusion parameters are not interfered with. Failure to use the security software together with the lockable cover could result in an inaccurate delivery leading to patient injury or death.

34. **WARNING: The lockable cover's safety-software interlocks are switched on by closing the syringe cover, not by turning the key in the lock. This means that it is perfectly possible to start an infusion with the cover closed but not locked - particularly if the pump is lying on a table so that the cover does not fall open under its own weight. Always ensure that the cover is locked before starting an infusion.**

35. **WARNING: When the Omnifuse™ syringe pump is fitted with an in-line occlusion sensor, the sensor, sensing disc and associated pressure sensing software should always be used in accordance with local protocol. The sensor can offer reduced time to an occlusion alarm *only* if the sensing disc is inserted and the sensing software is enabled. Failure to enable the in-line sensing software may result in an unacceptably slow time to occlusion alarm, resulting in patient injury or death.**

36. **WARNING: The Omnifuse™ syringe pump must be maintained, serviced and repaired only by properly trained and qualified technicians who have completed a Smiths Medical service training course. If any other personnel carry out such work it may result in inaccurate operation of the pump thereafter, leading to incorrect infusions and possibly causing injury or death to patients.**

37. **WARNING: Always disconnect the pump from the mains power supply before opening the case.**

38. **WARNING: While working on the pump, be careful not to get your fingers trapped in the pusher drive mechanism. The drive motor is powerful enough for you to be injured by it.**

39. **WARNING: It may appear that only the command wheel has been lost or damaged without affecting the optical encoder, and that repair only requires push-fitting a new wheel onto the encoder spindle. BEWARE! The encoder may also have been damaged without user knowledge, resulting in inaccurate infusions and possible injury or death to patients. Always run the Technician software Check Command Wheel test afterwards**

(see Chapter 5) even if a new command wheel has been fitted without opening the pump case.

40. **WARNING: DO NOT ATTEMPT TO REPAIR THE PUSHER BLOCK. Because of the delicate calibration of the internal pressure sensor, the block is supplied as a factory-sealed unit. Any attempt to open it will invalidate the warranty. Using the pump later may produce incorrect infusions, possibly resulting in patient injury or death. If the pusher block malfunctions, always replace the complete pusher drive assembly.**

41. **WARNING: The pump must correctly display the brand and the size of syringe that is to be used. Using a different brand or size of syringe to that displayed could lead to the incorrect amount of drug being administered, resulting in injury or death to the patient. When a new syringe-size sensor flag has been fitted, the pump must be carefully tested using the Technician software with the Smiths Medical syringe-size sensor gauge set (*part number 0151-0259*).**

42. **WARNING: The Technician software tests can be run either individually, in any order to isolate and correct a specific fault, or as a complete suite. However, if a pump case is opened for any reason, Smiths Medical MD, Inc. may invalidate the agreed warranty. Failure to run *all* Functional and Calibration tests after closing the pump case may result in incorrect operation, leading to inaccurate infusions that may cause injury or death to patients.**

43. **WARNING: While Smiths Medical have taken all reasonable steps to ensure that the pump operates correctly, while under remote control, it is the responsibility of the person who designs and implements the controlling device to ensure that the resulting system (pump and the controlling device) is fit for its intended purpose.**

44. **WARNING: The assessment for the suitability of any software/ firmware in the clinical environment to control or receive data from the pump lies with the user of the equipment. Any connecting analogue and digital components are required to meet BS EN600950-1:2002 / IEC 60950-1 (2001-10) for data processing and BSEN60601-1:1990 for medical devices.**

45. **WARNING: Any person connecting additional devices to the signal input or output is a system configurator and responsible for meeting the requirements of the system standard BS EN606010101:2001 / EIC 60601-1-1 (2000-12). Failure to do so may result in the compromised function of the product, patient injury or user injury.**

Cautions

Cautions tell you about dangerous conditions that may occur and cause damage to the pump if you do not obey all instructions in this manual.

1. **CAUTION: Refer all service, repair and calibrations to qualified technical personnel only. Unauthorised modifications to the pump must *not* be carried out.**

2. **CAUTION: When turning the pump on, if screens similar to those illustrated are not displayed, do not use the pump; send the pump to authorised service personnel.**

3. **CAUTION: Do not attempt to move the pump's pusher by hand. Always use the syringe Load key ⊖ to move the pusher to the right. Failure to observe this caution may cause mechanical damage to the pump.**

4. **CAUTION: Never carry the pump except by the handle. Failure to do so may result in damage to the case, or dropping the pump and causing internal damage.**

5. **CAUTION: Do not use cleaning and disinfecting agents other than the approved ones specified here.**

6. **CAUTION: The pump must *not* be immersed in any liquids or exposed to strong organic solvents. Wipe off spills immediately; do not allow fluid or residues to remain on the pump. Note that the pump is not designed to be autoclaved, steam-sterilised, ETO-sterilised or subjected to temperatures in excess of 45° C (113° F). Failure to observe this caution may cause serious damage to the pump.**

7. **CAUTION: Correct battery management as described in this manual is essential for ensuring that the pump can operate on backup batteries for the time specified.**
8. **CAUTION: Dispose of batteries strictly in accordance with the manufacturer's instructions and with local regulations concerning disposal. Lead-acid batteries must not be included with normal waste.**
9. **CAUTION: Do not use Loctite 222 adhesive on the pump since it will damage the plastic of the case.**
10. **CAUTION: Do not switch the pump back on after a System Fault if the screen message specifically says not to. Switching the pump on again may destroy important diagnostic information needed by the Smiths Medical Customer Support Engineers.**
11. **CAUTION: Replacing the main PCB and installing the lockable cover or in-line sensor as upgrades must only be performed by Smiths Medical Customer Support Engineers as the pump software must also be reconfigured.**
12. **CAUTION: Electro-Static Discharge (ESD) precautions conforming to BSEN 100015-4 (1994) must be strictly observed at all times when removing and handling any of the pump's components. Failure to take such precautions may result in serious damage to the pump and possible malfunction later. Ensure that an earthing wrist-strap is worn at all times when handling or working near static-sensitive components like printed circuit boards (PCBs). Ensure that any ESD-sensitive components are stored in an anti-static bag or other such container while not fitted.**
13. **CAUTION: If the main PCB is replaced, the pump must be reprogrammed by Smiths Medical engineers at the factory.**
14. **CAUTION: Lubricants must not be applied to any part of the pump unless specified by Smiths Medical MD, Inc. If the leadscrew runs jerkily or noisily, a smear of silicone grease (Smiths Medical MD, Inc. *part number 6835-2006*) may be applied to the leadscrew using a cotton bud. The screw must be run five times in each direction to spread the lubricant.**

Associated manuals and software

This manual should be read in conjunction with the following Smiths Medical MD, Inc. publications and software:

Title	Part Number
Omnifuse™ Syringe Pump Instruction Manual	0151-0839
Omnifuse™ PCA Syringe Pump Instruction Manual	0153-0082
Omnifuse™ Syringe Pump Technical User Manual	0151-0840
Omnifuse™ PCA Syringe Pump Technical User Manual	0153-0083
Omnifuse™ Syringe Quick Reference Guide	0151-0843
Omnifuse™ PCA Syringe Quick Reference Guide	0153-0080
Omnifuse™ Technician PC Software	0151-0266
Omnifuse™ Drug Protocol Management System	0153-0084

Service engineers must be familiar with the contents of the publications and the operation of the software before attempting any of the procedures in this manual.

Glossary

The following acronyms are used in this manual:

Abbreviation	Meaning
ADC	Analog-to-Digital Convertor
BME	Bio-Medical Engineering/ Engineer
CRC	Cyclic Redundancy Check
DVM	Digital Volt Meter
EOT	End of travel
FMS	Force Measurement Systems Ltd.
ID	Identification
KVO	Keep Vein Open
LCD	Liquid Crystal Display
LED	Light Emitting Diode
LSE	Leadscrew Encoder
MRI	Magnetic Resonance Imaging
PC	Personal Computer
PCA	Patient Controlled Analgesia
PCB	Printed Circuit Board
POST	Power-On Self-Test
PSU	Power Supply Unit
RAM	Random Access Memory
ROM	Read-Only Memory
TP	Test Point

Document History

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Issue A	Document published	November 2001
Issue B	PCA added; Phase IV update	February 2004
Issue C	Corporate name change	March 2005

Omnifuse™ Contents

Warnings and Cautions iii
Warnings iii
Cautions vi
Associated manuals and software vii
Glossary viii
Document History ix

Chapter 1 – Introduction

Scope of this manual ..... 1 - 1
Who should read this manual ..... 1 - 2
Related manuals ..... 1 - 2
Omnifuse™ ..... 1 - 2
Omnifuse™ PCA ..... 1 - 2
Product Overview ..... 1 - 3
System description ..... 1 - 3
Infusion modes ..... 1 - 3
Controlling the pump ..... 1 - 3
Technician Software ..... 1 - 4
Patient Controlled Analgesia (PCA) ..... 1 - 4
Cable and wrist strap ..... 1 - 4
Connection to pump ..... 1 - 4
Patient demand button and handset light ..... 1 - 4
Safety features ..... 1 - 4
Protocols ..... 1 - 5
Operation ..... 1 - 5
The drive mechanism ..... 1 - 5
The pusher ..... 1 - 5
The sensors ..... 1 - 5
Independant Battery Monitor ..... 1 - 6
System self-tests ..... 1 - 6
Interconnections ..... 1 - 7
Power Supply Unit PCB ..... 1 - 7
Main PCB ..... 1 - 8

Chapter 2 – Maintenance Procedures

Annual maintenance ..... 2 - 1
Preventive maintenance ..... 2 - 1
Care and replacement of batteries ..... 2 - 1
Battery replacement ..... 2 - 2
Tools and equipment ..... 2 - 4
Consumable Items ..... 2 - 5

Cleaning ..... 2 - 5
Disinfectants ..... 2 - 5
Technician Software ..... 2 - 6
Before using the Technician software ..... 2 - 7
Saving pump configurations ..... 2 - 7
Download the pump's history ..... 2 - 7
Return pumps to Smiths Medical International Ltd. ..... 2 - 7
Acceptance Tests ..... 2 - 8

Chapter 3 – Fault Diagnosis

Power supply ..... 3 - 1
Battery ..... 3 - 2
Main PCB ..... 3 - 2
Keypad/ display ..... 3 - 3
Command wheel/ optical encoder ..... 3 - 3
Drive mechanism ..... 3 - 3
Occlusion sensing ..... 3 - 4
Syringe-size sensing ..... 3 - 4
Syringe load / unload ..... 3 - 5
Optical interface ..... 3 - 5
Sounder ..... 3 - 5
PCA handset (if fitted) ..... 3 - 5
System faults ..... 3 - 6

Chapter 4 – Disassembly and Reassembly

Tools required ..... 4 - 1
Parts Replacement ..... 4 - 1
Items to be replaced at each disassembly ..... 4 - 2
Safety Precautions ..... 4 - 2
Open the pump case ..... 4 - 3
Replacing PCBs ..... 4 - 4
Power supply PCB ..... 4 - 4
Display PCB ..... 4 - 5
Independent Battery Monitor (IBM) PCB ..... 4 - 5
Optical interface PCB ..... 4 - 6
Optical encoder and/ or command wheel ..... 4 - 8
Optical encoder ..... 4 - 8
Command wheel ..... 4 - 9
Sounder ..... 4 - 9
Keypad ..... 4 - 10
Upper case (standard version) ..... 4 - 10
Remove components from the upper case ..... 4 - 10
Assemble a standard upper case ..... 4 - 10
Upper case (locking version) ..... 4 - 11

Remove components from a locking upper case ..... 4 - 12
Assemble a locking upper case ..... 4 - 13
Lower case .....4 - 13
Remove components from a lower case ..... 4 - 14
Assemble lower case ..... 4 - 15
Pole clamp ..... 4 - 20
Remove the pole clamp ..... 4 - 20
Assemble and secure the pole clamp ..... 4 - 20
Pusher Drive Assembly .....4 - 21
Pusher drive assembly removal ..... 4 - 21
Install pusher drive assembly ..... 4 - 22
Repair the syringe barrel clamp mechanism ..... 4 - 24
Syringe size sensor ..... 4 - 24
Syringe size sensor flag ..... 4 - 24
Barrel clamp spring arm ..... 4 - 25
Syringe ear clamp sensor ..... 4 - 26
Replace the ear clamp sensor flag ..... 4 - 27
In-line occlusion sensor (replacement only) ..... 4 - 27
Close the pump case ..... 4 - 29

Chapter 5 – Test and Calibration

Test sequence .....5 - 1
Basic tests ..... 5 - 1
Functional tests ..... 5 - 1
Calibration tests ..... 5 - 2
Logging repairs and part replacement .....5 - 2
Critical parts ..... 5 - 2
Test Equipment ..... 5 - 5
Test and Calibration Procedures .....5 - 6
Basic tests ..... 5 - 6
Functional tests ..... 5 - 6
Calibration tests ..... 5 - 8

Chapter 6 – Parts Lists

Supply of Spare Parts .....6 - 1
Fitting Spare Parts .....6 - 1
Main PCB .....6 - 1
Service spares kit .....6 - 9
Software .....6 - 10

Chapter 7 – Specifications and Standards

Omnifuse™ ..... 7 - 1
English/ Australian/ Canadian (English) ..... 7 - 1
French ..... 7 - 1
Dutch ..... 7 - 1
Omnifuse™ PCA ..... 7 - 1
English/ Australian/ Canadian (English) ..... 7 - 1
French ..... 7 - 1
Dutch ..... 7 - 1

Chapter 8 – Serial Communications Protocol

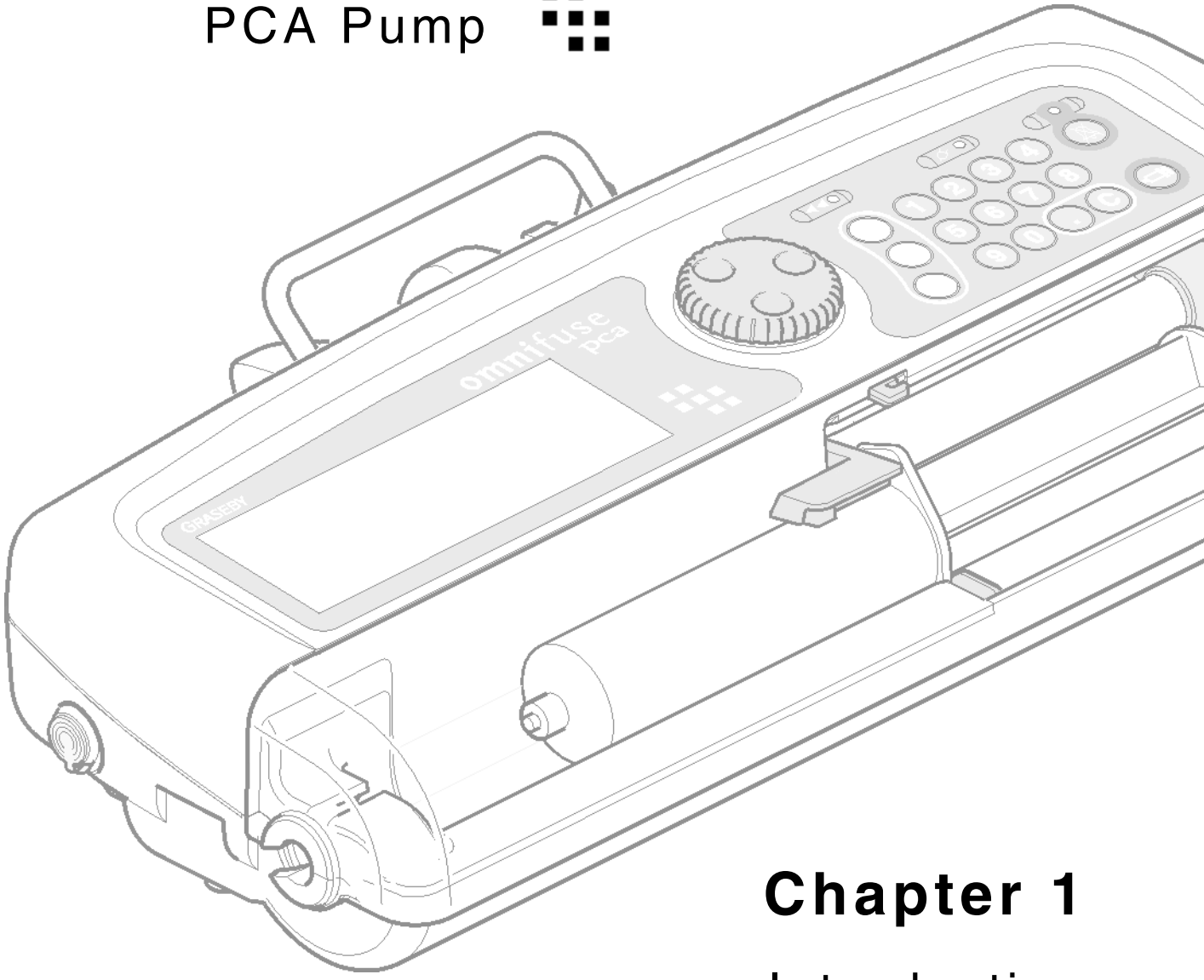
Introduction ..... 8 - 1
Organisation of this chapter ..... 8 - 1
Safety Considerations ..... 8 - 1
Bad Command received ..... 8 - 2
Pump Control fields and acceptable states ..... 8 - 3
Serial interface ..... 8 - 3
RS232 interface ..... 8 - 3
Channel Specification ..... 8 - 3
MESSAGE FORMAT ..... 8 - 4
Message Assembly ..... 8 - 6
Communications Link Control ..... 8 - 6
Connection ..... 8 - 6
Disconnection ..... 8 - 6
Pump delay response ..... 8 - 7
Error Handling ..... 8 - 8
Bad message received or Connection failure ..... 8 - 8
Enumerated Data ..... 8 - 9
Infusion modes (30 – 3F) ..... 8 - 10
Infusion units (40 – 4F) ..... 8 - 10
Message Errors and General Message Responses (50 – 8F) ..... 8 - 11
Mass Units Programming (90 – 9F) ..... 8 - 12
History storage (A0 – BF) ..... 8 - 13
Data formats and ranges ..... 8 - 14
Parameter Data ..... 8 - 14
Textual Data ..... 8 - 15
Commands and Responses ..... 8 - 17
Network messages ..... 8 - 17
Generic Information ..... 8 - 18
Infusion Device Commands ..... 8 - 24
Infusion Device Command Usage ..... 8 - 24
Infusion Device Commands Definition ..... 8 - 26
General Commands ..... 8 - 35
Infusion Control Commands ..... 8 - 38

History Commands .....8 - 41
Configuration Commands .....8 - 44
Technician Commands .....8 - 63

omnifuse™

Syringe Pump

PCA Pump



Chapter 1

Introduction

Chapter 1 – Introduction

This chapter briefly describes the Omnifuse™ syringe pump and its operating capabilities. For more detailed information of the pump's capability, refer to the manuals listed below.

Description

The standard Omnifuse™ syringe pump (Phase 3 and Phase 4) has no In-line occlusion sensing capability or Lockable cover. Omnifuse™ syringe pump variants are available for use in environments where In-line Occlusion Sensing or a Lockable cover are required.

The variants can be specified when the pump is purchased, or the standard pump can be upgraded to one of the variants, if it is returned to Smiths Medical.
The three variants are:

- Omnifuse™ syringe pump with In-line Occlusion Sensing
- Omnifuse™ syringe pump with Lockable Cover, and
- Omnifuse™ syringe pump with In-line Occlusion Sensing and Lockable Cover.

In-line Occlusion Sensing

For clinical applications where occlusion pressure needs to be monitored very precisely, for example in a Neonatal unit, the pump should be ordered with an in-line occlusion sensor.

Lockable Cover

The Lockable cover pump variant may be used in clinical areas where it is necessary to prevent the syringe from being removed and to prevent any change to the flow rate for the infusion.

The Lockable cover prevents physical access to the syringe except by an authorised person with a key. The cover can be used with the Omnifuse™ syringe pump security software enabled, which locks the keypad once the infusion is started. This prevents accidental changes to the infusion rate, or access to the bolus feature.

In-line Occlusion Sensing and Lockable Cover

The Omnifuse™ syringe pump is also available as a pump fitted with both the In-line sensor and the Lockable cover.

Note: **Technician Software** - The pump may only be tested or calibrated using the Omnifuse™ Technician Software, (*part number 0151-0266*).

Scope of this manual

This manual gives instructions for the service, repair and routine maintenance of the Omnifuse™ syringe pump and Omnifuse™ PCA syringe pumps.

The service manual is for use by qualified technicians e.g. customer biomedical engineers (BMEs) who may be required to service, repair and calibrate the pump and run acceptance tests after work has been completed.

The manual contains:

- an overview of pump operation,
- instructions for using this manual with the Technician software,
- a list of the tools and equipment required for servicing the pump,
- a list of acceptance tests,
- regular and preventive maintenance procedures, care of batteries etc,
- fault finding and troubleshooting procedures,
- service, repair and replace specific assemblies procedures,
- test and calibration procedures after major servicing or repair,
- an illustrated list of spare parts and accessories, and

- serial communications protocol.

Who should read this manual

This manual is for use only by suitably qualified personnel i.e. a qualified customer technician or BMEs who may be required to service or repair the Omnifuse™ syringe pump and calibrate and run acceptance tests when maintenance work has been completed.

Smiths Medical recommend that users of this manual should have attended a recognised Omnifuse™ syringe pump training course.

Related manuals

When operating instructions, specification, standards or trumpet curve information is required, refer to the appropriate manual(s) in the following list:

Omnifuse™ **Syringe Pump**

- Omnifuse™ syringe pump Instruction Manual, *part number 0151-0839*
- Omnifuse™ syringe pump Quick Reference Guide, *part number 0151-0843*
- Omnifuse™ syringe pump Technical User Manual, *part number 0151-0840*

Omnifuse™ **PCA Syringe Pump**

- Omnifuse™ PCA Syringe Pump Quick Reference Guide, *part number 0153-0080*
- Omnifuse™ PCA Syringe PumpTechnical User Manual, *part number 0153-0083*
- Omnifuse™ PCA Syringe Pump Instruction Manual, *part number 0153-0082*

This manual is used in conjunction with Omnifuse™ Technician software (*part number 0151-0266*).
Drug protocols are set-up using the Omnifuse™ Drug Protocol Management System (*part number 0153-0084*).
Both programs are supplied on CD-ROMs.

Omnistack™

Omnifuse™ Syringe Pump Stacking System Instruction Manual, *part number 0156-0084*.

WARNING: The Omnifuse™ syringe pump must be maintained, serviced and repaired only by properly trained and qualified technicians who have completed a Smiths Medical service training course. If any other personnel carry out such work, it may result in inaccurate operation of the pump thereafter, leading to incorrect infusions and possibly causing injury or death to patients.

Product Overview

System description

The Omnifuse™ syringe pump is used to administer drugs or other parenteral fluids. Designed to be as compact and damage-resistant as possible - including a high degree of waterproofing against spillage - the pump operates either above the patient, clamped obliquely to an intravenous (IV) pole mounting, or lying face upwards on a table.

Up to four pumps may be mounted on the Graseby Omnistack® pump stacking system.

The Omnifuse™ syringe pump normally runs from the AC mains supply. It also has a set of three internal rechargeable lead-acid backup batteries. When fully charged, the pump can operate for up to 10 hours in the event of a power cut or while a patient is being moved.

Three variants of the pump are available:

- with In-line occlusion sensing,
- with a Lockable cover, or
- with In-line occlusion sensing and Lockable cover.

Standard pumps can be upgraded to included either or both options.

Infusion modes

The standard pump can infuse in either Continuous, Preset-Volume or Preset-Time (not PCA) modes. The pump provides Intermittent and Circadian Rhythm infusions (not PCA), plus programming of infusions in mass units.

Delivery rates in the Continuous mode range from 0.1 to 100 millilitres per hour in 0.1 ml increments and 101 to 800 millilitres per hour in 1 ml increments. Maximum infusion pressure is approximately 1250 mm Hg, and volumetric infusion accuracy is ±2% over the 2nd hour of infusion at 1 ml/h and at 5 ml/h with a Braun Omnifix 50 ml syringe and 150 cm extension set.

Bolus can be administered either manually or as a preset volume at rates from 0.1 to 800 ml/h depending on syringe size. When the pump detects a nearly-empty syringe, it can infuse at a Keep Vein Open (KVO) rate. This can be set between 0.05 and 2 ml/h or turned off by setting it to zero.

The pump accepts syringes of 2 ml, 5 ml, 10 ml, 20 ml, 30 ml and 50/60 ml capacities (see either Technical User Manual or Instruction manual, *Specifications and Standards*). A clamping sensor detects syringe size at loading and suggests the most likely brand from among the pump's library of syringe types. Syringes can be purged at rates from 50 to 800 ml/h (depending on syringe size) before an infusion starts.

Users may define a syringe type of their own using the Configure feature on the Omnifuse™ Syringe Pump Technician PC Software.

Controlling the pump

The pump features an easily viewable LCD display which, together with an array of LEDs and sound signals, allows the pump's operation to be monitored from anywhere within sight and hearing range. The pump is controlled via a soft-touch keypad and a rotary command wheel that allows the user to select options from a succession of screen menus.

The pump can be factory-programmed to operate in one of a many languages. Whatever its primary operating language, each pump also allows technicians the option of viewing displays in English.

Authorised personnel can set-up and configure a pump using password protected Configuration and Technician menus.

Technician Software

RS232 interface allows the pump to be connected to a PC where it can be controlled remotely using the Omnifuse™ Syringe Pump Technician software.

Note: Only the correct RS232 cable, *part number 0053-0738* may be used.

The Technician software enables authorised personnel to:

- set-up and print the pump labels,
- add comments to the Repair Log,
- select the communication port,
- view or change pump parameters,
- view or change a user defined syringe parameter,
- review the pump history,
- calibrate settings, and
- run tests, record results and record replacement of critical parts.

Help screens describe the procedures.

Patient Controlled Analgesia (PCA)

The Omnifuse™ PCA syringe pump is designed for Patient Controlled Analgesia and is supplied with a patient handset and lockable cover. It can be used for a variety of PCA infusions which can be set up in the pump as protocols. It has a purple Command wheel, LCD surround and keypad.

Cable and wrist strap

The handset is connected to the pump by a purple cable which matches the pump and can be distinguished from any other cables.

Connection to pump

To connect the handset, the plug on the cable is pushed firmly into the socket on the left hand side of the pump.

Patient demand button and handset light

The handset button is used by the patient to demand a PCA dose. The light around the button can be set to switch on and off in one of three ways:

- on all the time, so the handset is easy to locate, even in the dark,
- on only when the patient's next PCA dose is available, or
- off all the time.

Safety features

Safety is designed into the pump and its software. Self-test routines check the pump when it is switched on. The mode, volume and duration of infusions, the syringe type being used and (optionally) the drug being administered are displayed for confirmation at each stage of an infusion. Levels of access to the pump can be configured from very restrictive - effectively a single type of infusion with the syringe under a locked cover - up to the most flexible, with clinicians able to choose from and combine a wide range of infusion modes, drug types and delivery options.

Users are warned of incidents like occlusions or power failure by both visible and audible alarms. In addition to standard occlusion sensing measured against the syringe plunger, optional in-line pressure sensing is available. With either type of sensing, it is possible to adjust the trigger pressure either to block out unwanted occlusion alarms or increase sensitivity e.g. in neo-natal units.

The pump stores a historical database of its own operation as each event takes place. It records the 3,000 most recent events, logging them by date and time.

The pump's history can be viewed either via the display, or in detail using the Omnifuse™ Syringe Pump Technician software package and a PC.

Protocols

The Omnifuse™ Syringe Pump Protocol Management System enables relevant hospital protocols to be pre-loaded in the pump. One-off infusions can also be set up using the *User Programmed* feature.

Operation

The Omnifuse™ syringe pump is built around an electric stepper motor driving a leadscrew.
The leadscrew moves the pusher block that depresses the syringe plunger. The volume of fluid infused over a given period is thus a function of the syringe barrel diameter and the distance that the pusher travels to press in the plunger. This means that the accuracy of the dose being administered is crucially dependent on (i) the accuracy of the motor/leadscrew mechanism, (ii) the pump correctly sensing what size of syringe has been loaded into it, and (iii) the physical characteristics of the syringe itself.

The drive mechanism

The stepper motor rotates the leadscrew within a nut fixed into the left-hand end of the pusher tube. The pusher block is fixed to the right-hand end of the tube, and as the leadscrew rotates the tube and pusher block slide along a guide rail on the drive chassis. When the motor turns anti-clockwise the leadscrew pulls the pusher block to the left so that it can engage with the head of the syringe plunger. The syringe ear clamp closes to hold the syringe in place and the pusher block then starts to press in the plunger. When the motor rotates clockwise the pusher block disengages from the plunger, then moves rightwards to its limit of travel and opens the ear clamp so that the syringe can be unloaded.

The microcomputer controls the speed of the motor and thus the distance travelled by the pusher in a given time. It does this by providing the motor with a pulse train calculated to produce the desired flow rate. The number of actual rotations is monitored by an opto sensor viewing a slotted disc on the motor end of the leadscrew. An alarm is generated if the sensor does not detect exactly the number of pulses that the microcomputer expects during a complete or partial revolution of the leadscrew.

The pusher

When the pusher block makes contact with the head of a syringe plunger, a pair of clamps engage to grip the head. Meanwhile the ear clamp closes to hold the syringe ear. If the plunger is accidentally dislodged during an infusion the pump immediately stops infusing and an alarm sounds.

The sensors

In addition to the leadscrew rotation sensor, the following sensors interact with the microcomputer to monitor and control the operation of the Omnifuse™ syringe pump.

Syringe size sensor - The system for detecting the size of the syringe loaded into the pump consists of a spring-loaded, manually operated clamp that closes onto the syringe barrel. As the clamp rotates, a flag on its swivelling end interacts with an opto sensor to report the clamp's final resting point as one of seven positions corresponding to seven possible syringe capacities between 2 ml and 50/60 ml. If a syringe does not correspond to one of these capacities or has been incorrectly loaded an **INVALID SYRINGE** alarm is given.

Occlusion sensor - When the pusher block contacts the plunger head during loading, a first-touch sensor inside the block signals to the microcomputer that a syringe is present. The clamp arms then close to grip the head of the plunger. If in-line occlusion sensing has not been installed (or has been disabled in the Configuration menu) a strain-beam pressure sensor inside the pusher block monitors the pressure on the plunger head throughout the infusion. The microcomputer gives an occlusion alarm if this pressure rises above a preset level.

In-line occlusion sensor (optional) - If the in-line occlusion sensor is installed, the liquid being infused flows through a small membrane-covered disc inserted into the line. As the liquid pressure increases, the membrane is forced outwards against a transducer within the sensor housing. This generates a voltage proportional to the pressure in the syringe and line. If in-line sensing has been enabled via the Configuration menu, this voltage is input to the microcomputer via an analog-to-digital convertor (ADC) which sets off an occlusion alarm if it exceeds a preset level. An opto sensor at the bottom of the housing detects the presence of the pressure-sensing disc. If the disc is removed during an infusion, an alarm is given. If in-line sensing is disabled for any reason, the pump immediately reverts to the standard method of occlusion sensing.

Power failure sensing - The sensing system immediately detects an AC power failure. If this happens, the pump continues to run for about 10 hours after switching automatically to its internal backup batteries (providing the batteries are fully charged).
The sensing circuits also include a system that monitors the batteries and raises an alarm if the output voltage drops below 5.75 V. When the voltage falls below 5.4 V, the pump turns itself off after a warning period of 30 minutes.

Independant Battery Monitor

The Independent Battery Monitor (IBM) board provides an audible alarm when the Omnifuse™ Omnifuse™ syringe pump internal battery falls to a level that causes the pump to stop at a rate too fast for the software battery detection system to operate.

The board interfaces with signals from the pump and determines that if a fault condition has occurred, the sounder mounted on the board is activated.

If the normal AC and battery power fails, a battery on the board provides emergency power to drive the alarm.

The IBM activates an alarm if:

- there is a battery fuse fault when the pump is running from batteries,
- Vin falls below the level required for the correct operation of the pump,
- Vin is high due to a fault on the charge circuit.

System self-tests

The pump's microcomputer carries out a series of self-tests at power-up. It also performs periodic tests on RAM, ROM, the power-supply voltage, the keypad, the system stack and the motor windings. The pump generates an alarm if it detects a connection failure while under external control.

Interconnections

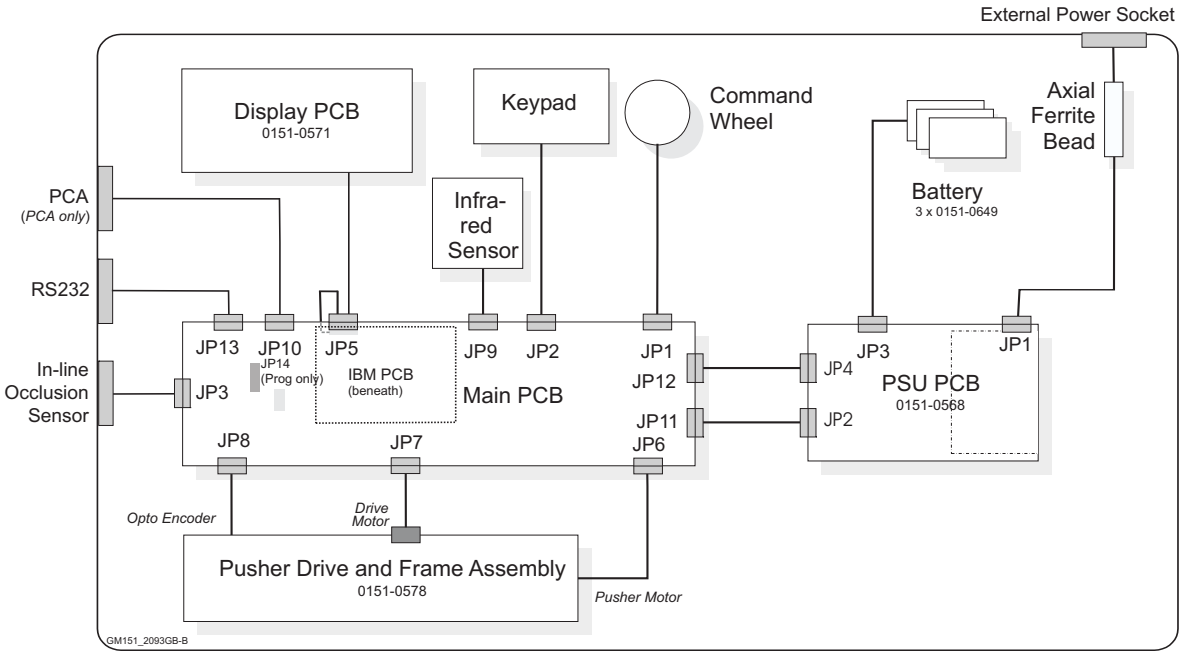


Figure 1-1 Omnifuse™ Syinge Pump Internal Connections

Details of the functions at each pin are listed in the following tables:

Power Supply Unit PCB

Connector	Pin No	Function
JP1 Power in	1	Not used
	2	Neutral
	3	Not used
	4	Live
	5	Not used
	6	Earth
JP2 PSU PCB (connects to JP11 on the Main PCB)	1	VCC
	2	-12 V
	3	0VS
	4	Battery current
	5	Battery voltage
	6	Main charge control
	7	Trickle control 1
	8	Trickle control 2
	9	Temperature
	10	Ext. power flag
	11	Volt cut
	12	Not used

JP3 Batteries	1	Battery +ve
	2	Battery -ve
JP4 PSU PCB (connects to JP12 on the Main PCB)	1	0VP
	2	0VP
	3	VIN to main PCB
	4	VIN to main PCB

Main PCB

Connector	Pin No.	Function
JP1 Command Wheel	1	Not used
	2	DR3
	3	KB_IN2
	4	ROT_ENCB
	5	ROT_ENCA
	6	VCC
JP2 Keypad	1	0VL
	2	0VL
	3	0VL
	4	0VL
	5	VCC
	6	ON/OFF_KEY
	7	KB_IN4
	8	KB_IN3
	9	KB_IN2
	10	KB_IN1
	11	KB_IN0
	12	Not used
JP3 In-line Occlusion Sensor	1	Pressure +
	2	Pressure -
	3	0VS
	4	0VL
	5	VREF H
	6	VCC
	7	WSD Enable
	8	WSD Detect

JP5 Display PCB	1	Cover Switch
	2	Brightness
	3	RED_BL
	4	VIN
	5	LCD_RST
	6	/LCD
	7	Data 15
	8	Data 14
	9	Data 13
	10	Data 12
	11	Data 11
	12	Data 10
	13	Data 9
	14	Data 8
	15	/HWR
	16	/RD
	17	AO
	18	Contrast
	19	VCC
	20	0VL
JP6 Pusher Motor	1	VREF
	2	VIN
	3	PUSHER_FORCE+
	4	PUSHER_FORCE-
	5	0VS
	6	0VL
	7	FTS
	8	FTSPUSHER_TX
	9	FTSPUSHER_RX
	10	+5 V_PUSHER
JP7 Drive Motor	1	VIN
	2	Phase B
	3	Phase B
	4	Phase A
	5	Phase A
	6	VIN

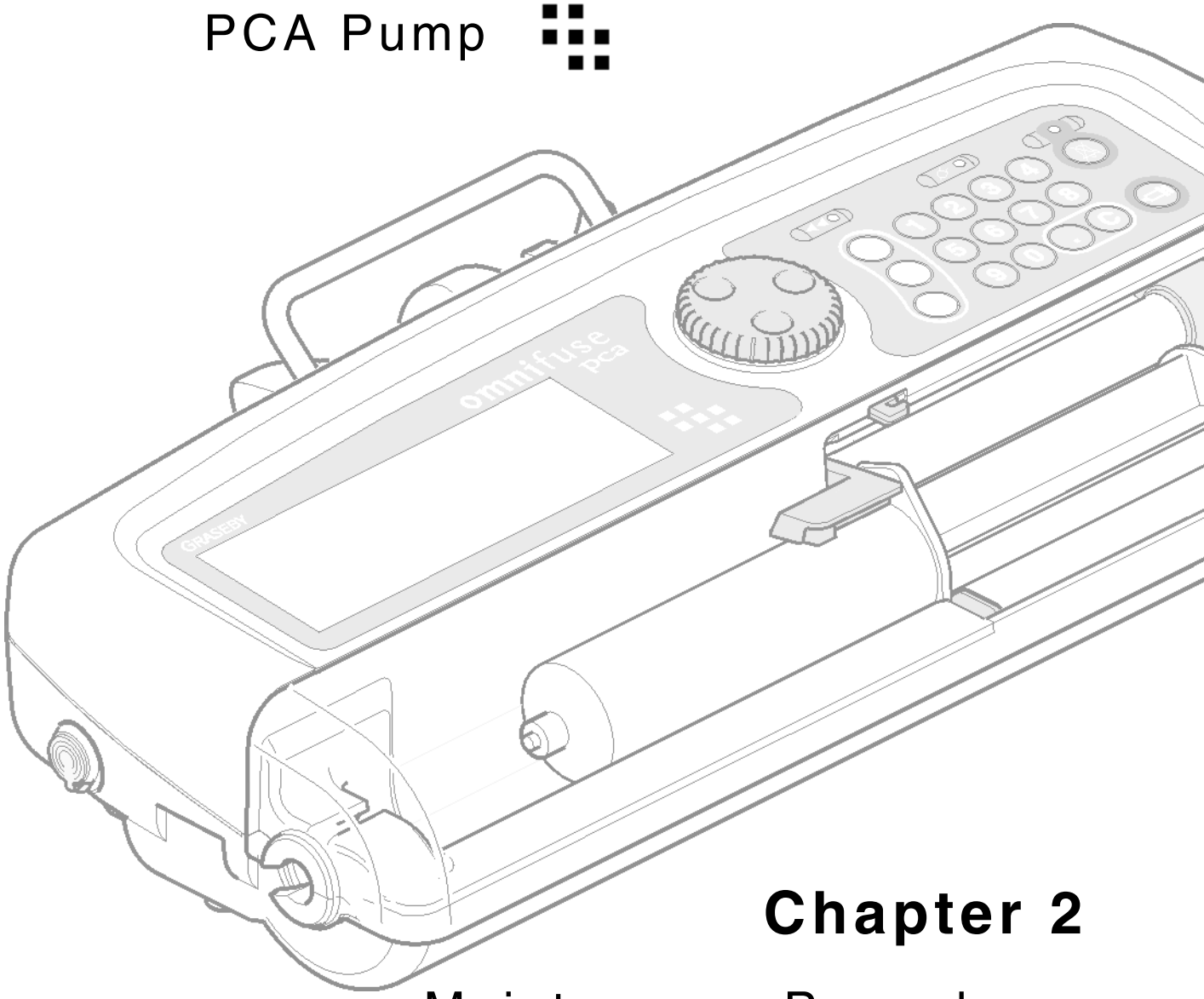
JP8 Opto Encoder	1	0VL
	2	0VL
	3	ENC A
	4	VCC
	5	VCC
	6	ENC B
JP10 PCA only	1	0VL
	2	Power 1
	3	Illuminate 1
	4	PCA State 1
	5	0VL
	6	Power 2
	7	Illuminate 2
	8	PCA State 2
JP11 Power (Secondary Processor)	1	Not used
	2	VOLT_CUT
	3	Ext. Power Flag
	4	TEMP
	5	TCHARGE_2
	6	TCHARGE_1
	7	Main Charge
	8	Battery Voltage
	9	Battery Current
	10	0VS
	11	-12 V
	12	VCC
JP12 (Power in from JP4 on PSU PCB)	1	0VP
	2	0VP
	3	VIN
	4	VIN

JP13 RS232	1	0VI
	2	Not used
	3	RTS0
	4	RX0
	5	CTS0
	6	TX0
JP14	Manufacturing use only	

omnifuse™

Syringe Pump

PCA Pump



Chapter 2

Maintenance Procedures

Chapter 2 – Maintenance Procedures

This chapter gives general instructions for routine service and maintenance of the Omnifuse™ syringe pump. It contains information on:

- annual maintenance of the pump,
- preventive maintenance, including care of batteries,
- tools and other equipment required for servicing and maintenance,
- cleaning the pump,
- use of the Technician software package, and
- acceptance testing at delivery and after major servicing.

Note: When connected to a PC, only the correct RS232 cable, *part number 0053-0738* may be used.

Annual maintenance

The following tests should be performed once a year using the Technician software to verify the pump's performance and calibration:

- basic tests (only include Voltage and ADC voltage tests if the pump case is opened during the Annual Maintenance)
- battery current test
- sensor test
- load/ unload and sensors test
- dry-side or in-line occlusion sensor test
- sounder test
- cover lock test
- optical interface test
- dry-side or in-line pressure sensor test
- rate test.

Details of tests and calibration procedure are given in Chapter 5 – *Test and Calibration.*

Preventive maintenance

Care and replacement of batteries

CAUTION: Correct battery management is essential to ensure that the pump can operate on backup batteries for the time specified.

The Omnifuse™ syringe pump is intended to work from the AC mains supply whenever possible. It is also equipped with three rechargeable lead-acid batteries that allow it to continue operating for up to 10 hours during a power failure or while a patient is being moved.

Since batteries deteriorate with age, they will require renewing. Their working life can be prolonged if the following steps are taken:

- Operate the pump from the AC mains supply whenever possible so that the batteries are always at or near full charge. Full discharge damages the batteries, so if it occurs, they should all be replaced as soon as possible.
- Always leave the pump connected to the AC mains supply, even when switched off, so that the batteries are constantly topped up.
- Never leave the pump for long periods with the batteries only partially charged e.g. storage.

Flat batteries take about 10 hours to fully recharge, provided that the pump is switched off throughout.

Note: If the batteries have been disconnected for any reason, the pump should be powered up for about six minutes after reconnection and then switched off and on again at the mains. This resets the battery power monitoring circuits. If this is not done, a continuous **LOW BATTERY** warning is displayed, even when the batteries are fully charged.

The batteries should be tested at least once a year. If one battery fails a test, ***all three*** should be renewed.

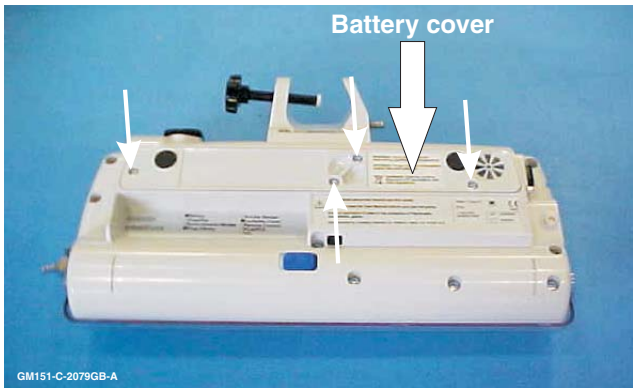
If a pump starts beeping and the **LOW BATTERY** warning appears almost as soon as the pump is disconnected from the mains supply, deterioration has occurred - even though the batteries should be fully charged. If this happens, run the Technician software Battery Current test at a variety of infusion rates, noting the results.

To check the battery condition, leave the pump connected to the mains but switched off for 10 hours so that the batteries are fully charged. Run an infusion at 5 ml per hour on battery power alone, unloading and reloading the syringe four times during the infusion. If the pump infuses for less than 10 hours, this means that the batteries need replacing.

Battery replacement

Note: Never replace a single battery; always change all three.

1. Switch off the pump, unplug it from the mains supply and invert it on a flat surface.
2. Unfasten the four retaining screws and remove the battery cover.



3. Peel off and discard the foam seal inside the battery cover.
4. Lift each of the batteries in turn from their compartments and carefully pull off the power-supply wiring loom connectors. Discard the batteries to avoid confusing them with the new ones.

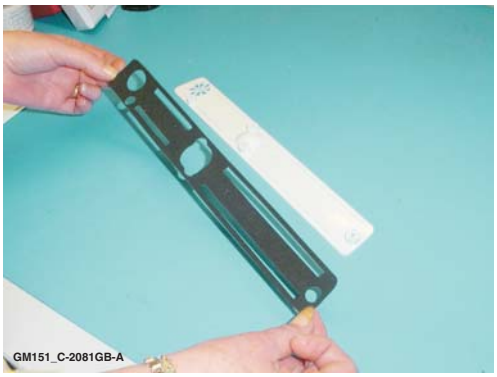
Note: The batteries fit very snugly in their compartment and require manipulation to remove.

CAUTION: Dispose of batteries strictly in accordance with the manufacturer's instructions and with local regulations. Lead-acid batteries must not be included with normal waste.

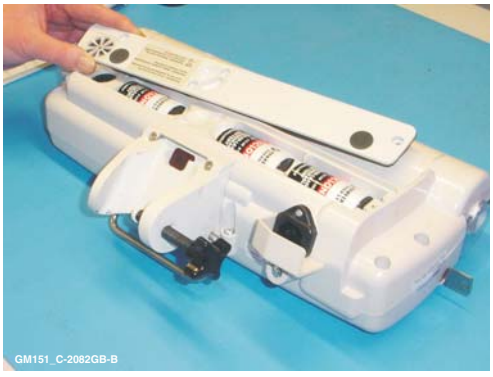
5. Push the wiring-loom connectors onto the terminals of the new batteries, ensuring correct polarity.

6. Peel the backing strip off the battery seal and fix the seal to the inside of the battery cover plate.

Note: A new battery seal is necessary. After a few weeks in place, the old one will have lost some of its elasticity. Attempting to re-use a seal may cause the battery compartment be less watertight.



7. Locate the batteries in their compartments. Locate and secure the battery cover plate with the four retaining screws.



8. Connect the pump to a PC with the RS232 connector and run the Technician software Battery Current test.

Note: Only the correct RS232 cable, *part number 0053-0738* may be used.

9. Connect the pump to the mains electricity supply. Switch on for six minutes then switch off at the mains to reset the battery power detector.

10. Switch the pump on again so that the batteries can charge. This takes about 10 hours.

Tools and equipment

The following tools and equipment are required for servicing, repairing or upgrading an Omnifuse™ syringe pump.

Item	Smiths Part Number or Suggested Type
PC: Pentium 100MHz or above with at least 32 Mb of RAM, RS232 interface and printer. Must be running Windows 95™ or later (see *Omnifuse™ Technician Software* booklet supplied with the CD ROM for details).	--
Omnifuse™ Technician Software CD-ROM	0151-0266
Digital multimeter	Fluke 79 111
Sound level meter (analog)	Castle GA206
60 MHz Oscilloscope	Tektronix TDS210 or similar
Optical checking fixture	Part of Service Spares Kit (0151-0658)
Occlusion set-point indicator (FMS GM74-564): matched and calibrated with set-point transducer below (jointly known as 'the Load Cell' for test purposes).	0151-0287
Occlusion set-point transducer (FMS GM74-565): matched and calibrated with set-point indicator above (jointly known as the 'Load Cell' for test purposes).	
Syringe size-gauge set: 8 mm, 12 mm, 13 mm, 14 mm, 21 mm, 25 mm and 35 mm	0151-0259
Pneumatic transducer tester	Dale20. Bio-Tek® DPM-1B
Philips screwdriver No. 1	--
Philips screwdriver No. 2	--
Screwdriver, flat-blade 4 mm x 150 mm	--
Torque screwdriver: adjustable 20 – 100 cNm	--
T10 torx driver (right-angled)	--
4 mm AF socket with appropriate driver	--
11 mm AF socket with appropriate driver (deep)	--
Pliers, small	--
Connector inserter/ extractor tool	--
2/ 5 ml, 20 ml, 50 ml disposable syringe (any brand)	--
Flo-Safer™ disposable extension set with in-line pressure sensing disc.	0130-0041

Consumable Items

The following consumables are required:

- Silicone sealant (RTV3145 or similar)
- Adhesive (Loctite 406 or similar)
- Silicone grease (Smiths Medical International Ltd. *part number 6835-2006*)

CAUTION: Loctite 222 adhesive must never be used on the pump since it will damage the case plastic.

Cleaning

WARNING: Following a significant liquid spill onto the pump, it should be wiped dry and inspected by service personnel before being returned to service. Failure to do so may result in compromised functioning of the pump, leading to patient or user injury or death.

CAUTION: Do not use cleaning and disinfecting agents other than the approved ones specified here.

The Omnifuse™ syringe pump is designed to be water-resistant against accidental spillages, but not waterproof. The casing and outer surfaces of the pump should be cleaned using a damp cloth, or if necessary a cloth dampened with a mild solution of washing-up liquid.

1. For pumps with a lockable cover, remove the cover before cleaning it.
2. Wipe the exterior surfaces of the pump, paying particular attention to the barrel clamp and the syringe ear slot. To clean beneath the syringe pusher block, switch on the pump and load an empty syringe so that the block moves left.
3. When cleaning is complete, disinfect the pump using a suitable disinfectant solution and remove any disinfectant residue by wiping with a clean damp cloth.
4. After cleaning and disinfection, remove the syringe and replace the lockable cover.

Disinfectants

Disinfect the casing of the pump either with a cloth dampened in a solution of sodium hypochlorite (0.2%), or with alcohol wipes intended for disinfecting equipment.

A suitable disinfectant solution can be made by diluting sodium hypochlorite with water to give a solution of 0.1% available chlorine. Preferably use a freshly made solution, and do not use one which is more than 24 hours old.

Technician Software

The Omnifuse™ Syringe Pump Technician software package, supplied on CD-ROM, allows communication between the pump and a PC via the RS232 interface in order to perform tests and calibration during servicing.

Note: The Technician software is an integral part of the Omnifuse™ syringe pump tool kit. The pump cannot be serviced without it. Only the RS232 cable, *part number 0053-0738* may be used.

The software:

- Performs tests and calibration on the pump during servicing.
- Enables and disables options and set parameters normally changed via the pump's own Configuration and Technician menus.
- Examines and downloads the pump history
- Maintains the pump service database.
- Stores the pump configurations and settings which can then be restored after servicing.
- Prints pump records.

The Technician software has its own comprehensive system of on-screen helps to guide the user through each stage of the process.

Note: Before loading and running the Technician software check that the PC screen resolution has been set to at least 800 x 600 pixels with 16K colours and small normal font, otherwise the screen will be distorted.

To use the Technician software package:

1. Switch on the pump, ensure that the interface cable is connected between the PC COM port and the RS232 connector on the pump. Only the RS232 cable, *part number 0053-0738* may be used.
2. Load the CD-ROM into the PC CD-ROM drive.
3. If Autorun is not activated on the PC, install the software on PC by clicking on **`setup.exe`** and following the installation instructions on the opening setup menu.
4. To use the software, ensure that the pump is either in **INFUSION** mode or load the syringe with the barrel clamp open. Double-click on the Technician icon or on **Start /Programs /Smiths Medical/Omnifuse™ Technician Software**.
   Before continuing, confirm the software version for the pump. If it is 8.0 or above, click on **OK**. If it is 7.9 or less, click on **Cancel** and run the Omnifuse™ Syringe Pump Technician Software version 1.5.2 (*part number 0151-0263 issue B*).
5. Enter your name in the **Validation of user authorisation** dialog box and click on **OK**.
   - If you have the *pump connected*, click on **Attach Pump and Get Log**.
   - If the *pump is not connected*, either enter the 8-digit serial number in the **Serial Number:** box, or if a Repair Log already exists, select the serial number from the drop down list. Click on **Select Serial No. and Get Log**.
6. The functions for the software are on the menu bar. Click on:
   - **File** to print labels and create path settings (or quit),

- **Configure** to select the PC communication port and baud rate, view the pump options, configure the pump, or define the syringe,
- **History** to download or view the pump history,
- **Calibrate** to access pump calibrations,
- **Test** to access the pull-down menu of tests, or
- **Change** to call up the **Log replacement of PCBs and Critical Parts for pump**.
- **Help** to access the Help file, Service Manual, selct Help display, register the software and display the software information.

7. When the selection has been made, follow the sequence of screens, clicking on **Help** when required.

Before using the Technician software

Before using the Technician software to service the pump:

- Save the existing pump configurations so that they can be restored afterwards.
- Download the pump's history and save it in case of accidents during servicing.

Saving pump configurations

To save the pump's existing configurations so that they can be restored later:

1. With the Technician Software running, connect the pump and power-up.
2. Click on **Configure / Configure Pump...** on the menu bar. Select the pump type and click on **OK** to continue. The **View/Change pump configuration** window is displayed.
3. Click on **Get Current Configuration from Pump** to download the current configuration from the pump to the PC, and then save to disk.

Download the pump's history

1. With the Technician Software running, connect the pump and power-up.
2. Click on **History /Download...** and follow the on-screen instructions to download the history from the pump to the PC.
3. Select **View** to view the pump's history.
4. Enter the pump's serial number and click on **Open History**.
5. Select the required option from the buttons in **Pump History**.

Return pumps to Smiths Medical International Ltd.

If a pump cannot be serviced locally and needs to be returned to the factory for repair, its service log will be downloaded at Smiths Medical International from the pump's internal memory. If the main PCB has failed so badly that the service log cannot be retrieved you may be asked to send Smiths Medical International a copy of the log taken from your PC.
To do this:

1. Open folder where your history files are stored and e-mail the record to:
   Service@Smiths-medical.com
2. Alternatively, print off a copy of the Repair Log and mail it to:

   Smiths Medical International Ltd.,
   Repair Centre,
   Colonial Way,
   Watford,
   Hertfordshire,
   United Kingdom,
   WD24 4LG

Acceptance Tests

The following tests must be completed on new pumps on delivery, and pumps returned from Smiths Medical after repair, service or upgrade. Faulty units should be returned.

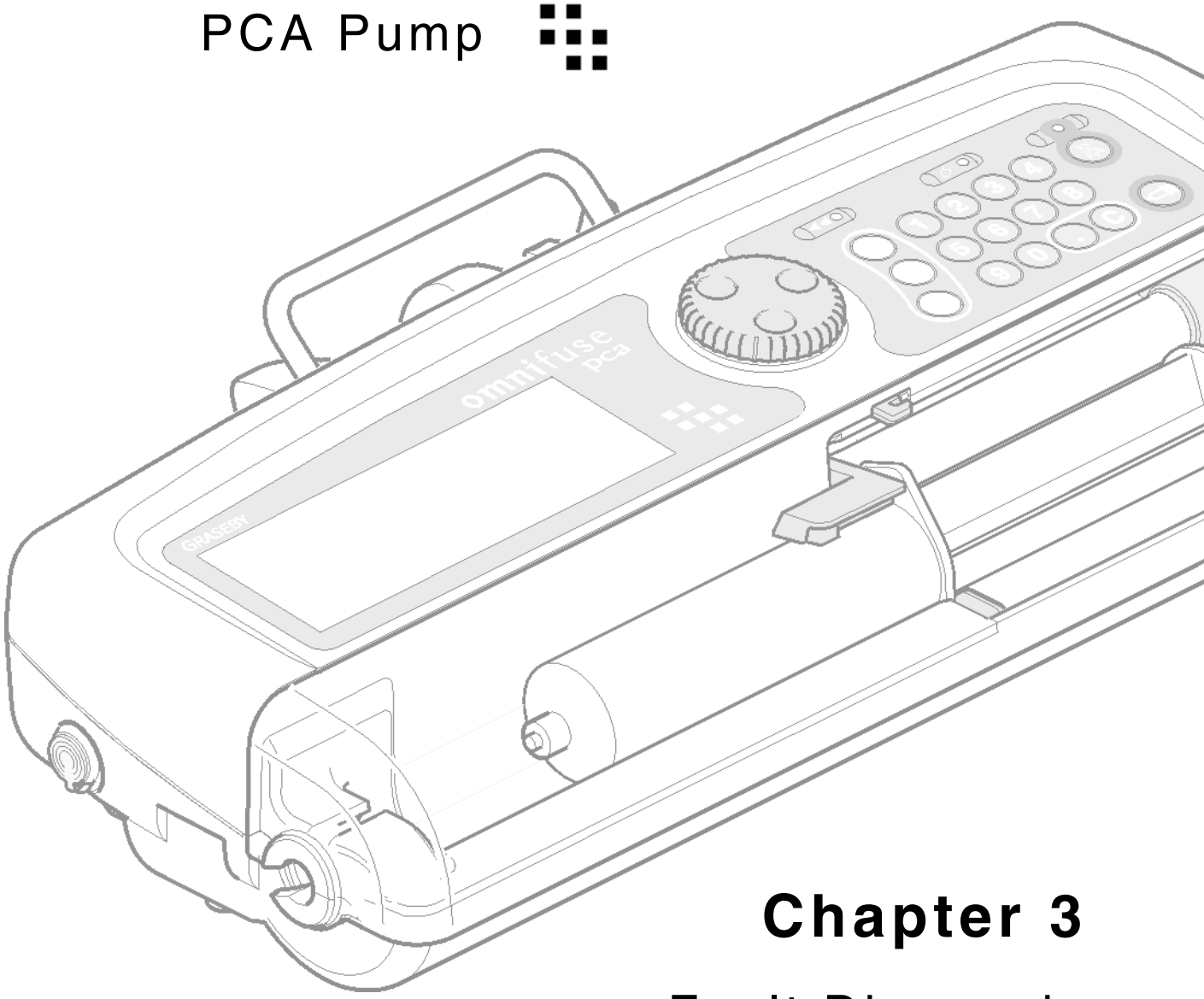
	Test	Method	Correct Result
1	Mechanical inspection.	Before applying power, ensure that the case and exposed parts are not damaged.	No visible damage.
2	Electrical safety test.	Using a test voltage of 500V DC, measure the insulation resistance between the mains inlet and exposed metal parts.	The insulation must exceed 200 Mohm (or per site regulations).
3.0	Initial power on.	With the AC mains supply *not* connected: Press the On/Off key ⏻.	Ensure that the following events occur in the order shown: • A single beep sounds. • All three LEDs illuminate. • The LCD display turns **RED**. • The message **PERFORMING SELF TEST** is displayed. Then: • A single beep sounds and all LEDs extinguish. • The infuse LED briefly illuminates orange. • The screen changes to **LOAD SYRINGE** or Confirm Syringe.
3.1		Connect AC mains supply.	The yellow AC mains supply LED illuminates.
4.0	Keyboard tests – AC connected.	Press and hold the On/Off key ⏻ for about three seconds.	The display goes blank and the yellow **AC** LED remains illuminated.
4.1	Keyboard tests. AC connected.	Press the On/Off key ⏻.	As 3.1.
4.2		Press all the keys on the numeric keypad in turn (press the On/Off key ⏻ very briefly).	Ensure that the Lockable cover (if fitted) is open and that a brief beep sounds as each key is pressed.
4.3	Command wheel checks.	Using the Command wheel, select and confirm a **CONTINUOUS** infusion with a BD Plastipak syringe fitted and select a rate of 99.9 ml/hr.	Check that the Command wheel can change the operation of the pump and that it can confirm selections.
5.0 **PCA** only	Handset check	Enter the Technician menu, select and run the **Test PCA handset**.	Refer to the PCA Technical User Manual, *part number 0153-0083.*

6.0	AC mains failure.	Start the infusion (see 4.3). Remove or switch off the external AC mains supply.	Ensure that as the infusion runs, the infusion LED flashes green. Ensure that the alarm sounds intermittently and the message **AC MAINS FAILURE** is displayed, but the pump continues to run on the internal batteries. Ensure that the screen returns to the Infusion screen and that the message **AC MAINS FAILURE** appears on it. Check that the error screen is displayed periodically with a double beep.
		Reconnect the AC supply.	Ensure that the yellow **AC** mains LED illuminates and that the error message is no longer displayed.
		Press the Stop key ⓞ.	Ensure that the green Infusion LED shows steady and that the Infusion screen shows the infusion status.
		Press the Start key ⓞ.	Run the infusion through the Near Empty Point sequence and that it flashes amber.
		Press and hold the On/Off key ⓞ for about three seconds.	The display goes blank and the yellow **AC** LED remains illuminated.

omnifuse™

Syringe Pump

PCA Pump



Chapter 3

Fault Diagnosis

Chapter 3 – Fault Diagnosis

This chapter identifies the major symptoms, possible causes and corrective actions when making a preliminary fault diagnosis on the Omnifuse™ syringe pump.

The Technician software and visual inspection may be used to locate faults more precisely.

Note: When connected to a PC, the correct RS232 cable, *part number 0053-0738* ONLY may be used.

The tables list possible faults in the following:

- power supply unit PCB
- battery
- main PCB
- keypad/ display
- command wheel/ optical encoder
- drive mechanism
- occlusion sensing
- syringe size sensing
- syringe load/ unload sequence
- optical interface
- sounder
- PCA handset (if fitted).

Chapter 2 *(Maintenance Procedures*) and Chapter 4 (*Disassembly and Reassembly Instructions*) gives information on correcting faults.

Power supply

Symptom	Possible Causes	Action
Pump does not power up at switch on: AC mains power LED dead. **Note**: This only occurs if batteries are not charged.	Pump not plugged in.	Check the mains lead at each end.
	Current not switched on at mains.	Switch on at the mains.
	Power cut.	Check whether other appliances on the same supply are also dead.
	Fuse blown.	Check the mains lead plug and fit new fuse if necessary.
	Power supply unit PCB failed.	Ensure fuses F3 or F4 on the PSU PCB are not blown[1]. Run the Check Voltages test. Fit a new power supply PCB if necessary.
AC MAINS FAILURE warning while pump running.	Pump unplugged from mains.	Check the mains lead at both ends.
	Current switched off at mains.	Switch on at the mains.
	Power cut.	Check whether other appliances on the same supply are also dead.
	Fuse blown.	Check the mains lead plug and fit a new fuse if necessary.

[1] Two 4A micro-fuses (F3 and F4) are mounted on the Power Supply Unit PCB. When changing either fuse, ensure that the AC mains power is disconnected and that the batteries are disconnected. If F1 or F2 fail, the pump should be sent to Smiths Medical International Ltd. for service.

Battery

Symptom	Possible Causes	Action
Constant **LOW BATTERY** warnings, even though batteries are fully charged.	Battery power indicator not reset after replacing batteries.	To reset, switch the pump on for 6 minutes then off at the mains. Switch on again to charge batteries.
	Dead batteries.	Run the Battery Current test and fit new batteries if necessary.
BATTERY FAULTY warning.	Battery connectors displaced.	Remove the battery cover and check integrity and correct polarity of battery wiring-loom connectors.
	Damaged or dead batteries.	Run the Battery Current test and fit new batteries if necessary.
	Faulty Power supply unit PCB.	Run the Check Voltages tests and fit a new Power supply unit PCB if necessary.
BATTERIES DEAD warning.	Failed batteries.	Run the Battery Current test and fit new batteries if necessary.
	Faulty Power supply unit PCB.	If the Battery Current test shows batteries OK, run the Check Voltages tests and fit a new Power supply unit PCB if necessary.

Main PCB

Symptom	Possible Causes	Action
Pump fails to enter self-test routines.	Defective main PCB.	Connect to PC and if no communication is possible, return the pump to Smiths Medical International Ltd. for replacement of the main PCB.
Pump enters self-test routines, then stops with a **SYSTEM FAULT xx** message.	Microprocessor or sensor fault detected.	Press alarm silence key twice. If the fault persists, return the pump to Smiths Medical International Ltd. for replacement of the main PCB.

Keypad/ display

Symptom	Possible Causes	Action
Pump powers up, beeps and responds to key presses, but the display remains dead.	Failed display.	Run the Check Keypad and Display test and fit a new display PCB if necessary.
Pump powers up and goes through start up sequence, but fails to respond to one or more key presses.	Keypad failed.	If the display still responds to the command wheel, run the Check Keypad and Display test. Fit a new upper case assembly if necessary.

Command wheel/ optical encoder

Symptom	Possible Cause	Action
Command wheel has an erratic effect or no effect on display.	Failing or failed optical encoder.	Run the Check Command Wheel test. Fit a new optical encoder if defective.

Drive mechanism

Symptom	Possible Causes	Action
Pusher block fails to travel to limits, or moves jerkily with a loud grinding noise.	Leadscrew dry.	Apply a smear of silicone grease (Smiths Medical International Ltd. *part number 6835-2006*) to the leadscrew using a cotton bud and run the screw five times in both directions to spread the lubricant.
	Worn or damaged leadscrew and/or nut.	Fit a new pusher drive assembly if necessary.
Pusher block fails to travel to limits, or moves jerkily with a loud grinding noise.	Leadscrew dry. Worn or damaged leadscrew and/or nut.	Apply a smear of silicone grease (Smiths Medical International Ltd. *part number 6835-2006*) to the leadscrew using a cotton bud and run the screw five times in both directions to spread the lubricant. Fit a new pusher drive assembly if necessary.
Pusher block moves a little then stops.	Failing opto sensor.	Check the ADC output and fit a new pusher drive assembly if necessary.
Pusher block travels erratically, or stops and signals **SYSTEM ERROR**.	Failing drive motor.	Fit a new pusher drive assembly if necessary.

Occlusion sensing

Symptom	Possible Causes	Action
Pump gives continuous occlusion alarms for no reason.	Occlusion sensor not calibrated.	Run the Pressure Sensor, Dry-Side or Pressure Sensor, In-Line test. If necessary, either: • fit a new pusher drive assembly, or • recalibrate the in-line occlusion sensor using the Technician software.
Pump fails to give occlusion alarms.	Failed occlusion sensor.	Run the Occlusion Sensing, In-Line or Occlusion Sensing, Dry-Side tests. If the tests fail, either: • fit a new pusher drive assembly, or • fit a new in-line occlusion sensor.

Syringe-size sensing

Symptom	Possible Causes	Action
Pump gives **NO SYRINGE LOADED** alarm even when syringe is correctly loaded.	Syringe-size opto sensor failing or flag damaged.	Examine the opto sensor flag. If the flag is damaged, fit a new flag. If OK, run the Check Syringe Size Sensor test. Return the pump to Smiths Medical International Ltd. if the sensor is defective.
Pump rejects all syringes as invalid.	Syringe-size opto sensor failing or flag damaged.	Examine the opto sensor flag. If the flag is damaged, fit a new flag. If OK, run the Check Syringe Size Sensor test. Return the pump to Smiths Medical International Ltd. if the sensor is defective.
Pump misreports size of loaded syringe.	Syringe-size opto sensor failing or flag damaged.	Examine the opto-sensor flag. If the flag is damaged, fit a new flag. If OK, run the Check Syringe Size Sensor test. Return the pump to Smiths Medical International Ltd. if the sensor is defective.
Clamp arm fails to clamp onto syringe barrel.	Broken clamping spring arm.	Replace the pusher assembly.

Syringe load / unload

Symptom	Likely Causes	Action
Pump gives **LOAD NOT COMPLETE** or **OBSTRUCTION** alarm even though syringe loading apparently correct.	Defective motor or leadscrew (possibly combined with low battery power) causes the pusher block to travel too slowly, or the drive opto sensor failing.	Run the Sensors and Load/ Unload and Sensors tests. If necessary, fit a new pusher drive assembly.
Pump gives **EAR NOT CLAMPED** alarm even though syringe ear is properly clamped.	Damaged ear-clamp sensor flag.	Replace the pusher assembly.

Optical interface

Symptom	Likely Cause	Action
Optical interface fails to respond.	Optical PCB defective.	Run the Optical Interface test. If necessary, fit a new optical PCB.

Sounder

Symptom	Likely Cause	Action
Sounder fails to beep at power up and generates system fault.	Sounder ribbon cable not properly connected to PCB.	Check that the ribbon cable connector is pushed fully home into socket.
	Failing or failed sounder.	Run the Sounder test. If necessary, fit a new sounder.
Sounder does not make expected noises, or at wrong intensity.	Failing main PCB.	Run the Sounder test. If the sounder unit is OK, return the pump to Smiths Medical International Ltd. for replacement of the main PCB.

PCA handset (if fitted)

Symptom	Likely Cause	Action
Handset fails to deliver an infusion.	• Faulty connection. • Pushbutton failure. • LEDs inoperative.	Select **Test PCA handset** from the Technician menu on the pump and run the tests. If the handset fails any of the tests, fit a new handset.

System faults

If a serious internal error occurs, the following System Fault messages may appear on the LCD display. The pump also sounds a continuous alarm.
The alarm can only be silenced by switching off the pump.

CAUTION: Do not switch the pump back on again after a System Fault if the screen message specifically tells you not to. Switching the pump back on may destroy important diagnostic information needed by the Smiths Medical International Ltd. service engineers.

The large message gives the fault number while the message in smaller letters gives a description of the fault and tells you what to do next.

Fault Message	No.	Description	Action
POST - Primary Processor Program ROM CRC test failure	1	The primary processor ROM has failed its power on self test (CRC mismatch).	
Secondary Processor Program ROM fault at power up	2	The secondary processor ROM has failed its power on self test (CRC mismatch).	
Primary Processor Program ROM fault while running	3	The primary processor ROM has failed its background diagnostic test (CRC mismatch).	
Primary Processor RAM fault at power up	5	The primary processor RAM has failed its power on test.	
Secondary Processor RAM fault at power up	6	The secondary processor RAM has failed its power on test.	
Primary Processor RAM fault	7	The primary processor RAM has failed its background diagnostic test.	
Secondary Processor RAM fault	8	The secondary processor RAM has failed its background diagnostic test.	
Primary Processor non-volatile (NV) memory fault (tested at POST only)	9	The primary processor non-volatile memory has failed its power on test (CRC mismatch).	
Primary Processor non-volatile (NV) memory fault, history storage write failure	10	The primary processor has failed to write data into the History store correctly.	
Primary Processor non-volatile (NV) memory fault, configuration storage write failure	11	The primary processor has failed to write data into the Configuration store correctly.	
Secondary Processor NV memory fault	12	The secondary processor non-volatile memory has failed its power on test (CRC mismatch).	

Secondary Processor NV memory fault, write failure	13	The secondary processor has failed to write data into the associated non-volatile memory correctly.	
Inter-processor communications failure (POST)	16	The inter-processor communication could not be established at start up.	
Inter-processor communications failure	17	The inter-processor communication has failed.	Occurs if the pusher is not connected.
Primary Processor external watchdog failure (sleeping fault). **Failure mode, no time out.**	18	The primary processors watchdog has failed its timeout test. No watchdog timeout was detected during the power on tests.	
Primary Processor external watchdog failure (sleeping fault). Failure mode, time out too soon.	19	The primary processors watchdog has failed its timeout test. The watchdog timeout too soon during the power on tests.	
Key stuck down	21	Keyboard scanning code detects that a key has been continuously pressed for >8 secs. Initially this only applies to the **STOP** key.	Run Check Keypad and Display test.
Sounder failure	22	The power on test of the sounder has failed.	Run Sounder test.
Keyboard fault	23	A key press (other than the **ON/ OFF** key) was detected during power on tests.	Run Check Keypad and Display test.
Unexpected primary processor reset	24	The primary processor was reset unexpectedly.	
Unexpected secondary processor reset	25	The secondary processor was reset unexpectedly.	
Illegal op-code executed, primary processor	26	The primary processor has detected the execution of an illegal instruction.	
Illegal op-code executed, secondary processor	27	The secondary processor has detected the execution of an illegal instruction.	
Unexpected interrupt, primary processor	28	The primary processor has received an unexpected interrupt.	
Unexpected interrupt, secondary processor	29	The secondary processor has received an unexpected interrupt.	
Motor speed (in step/unit time) calculation error	31	The results of the two separate motor speed calculations do not match each other. It may not be safe to continue with the infusion.	Check motor/ leadscrew and opto sensor.

Motor over speed	32	The independent motor speed monitoring has detected that the motor is running too fast. It may not be safe to continue with the infusion.	Check motor/ leadscrew and opto sensor.
Motor under speed	33	The independent motor speed monitoring has detected that the motor is running too slow. It may not be safe to continue with the infusion.	Check motor/ leadscrew and opto sensor.
Motor disable does not disable motor (sleeping fault)	36	The independent motor speed monitoring did not stop the motor when tested. It may not be safe to continue with the infusion.	Check motor/ leadscrew and opto sensor.
Motor control request not consistent with current motor monitoring settings	37	The independent motor speed monitoring has detected an unexpected motor step sequence. It may not be safe to continue with the infusion.	Check motor/ leadscrew and opto sensor.
Plunger movement detected	38	Unexpected movement of the plunger has been detected.	Run Load/ Unload and Sensors test.
Clamping arms stuck or sensor failure	39	The fully open position of the clamping arms could not be detected. This may be because the arms are stuck or because the arms open sensor has failed.	Run Sensors test.
End of travel sensor fault	40	A test of the end of travel (EOT) sensor has failed.	Run Sensors test.
End of travel sensor fault	41	No end of travel was detected during the syringe unloading sequence. Unloading was stopped because the maximum unload time was exceeded.	Run Sensors test, then check motor/ leadscrew and opto sensor.
First touch sensor fault	43	The first touch sensor within the pusher failed its test.	Run Sensors test.
Occlusion sensor fault	44	The dry-sensor pressure sensor within the pusher failed its test.	Switch **OFF** the pump, clear the message and press Load key. If fault persists, run the Pressure Sensor (Dry Side) test.
Ear clamp sensor fault	45	The ear-clamp sensor failed its test.	Run Sensors test.
Dry side pressure sensor fault: zero reading out of range	46	The dry-side pressure sensor could not be zeroed.	Run Pressure Sensor (Dry Side) test.

Dry side pressure sensor fault: common mode out of range	47	The dry-side pressure sensor common mode voltage was out of range.	Run Pressure Sensor (Dry Side) test.
Dry side pressure sensor fault: negative reading	48	The dry-side pressure sensor reading was negative.	Run Pressure Sensor (Dry Side) test.
In-line pressure sensor fault: zero reading out of range	49	The in-line pressure sensor could not be zeroed.	Run Pressure Sensor (In-Line) test.
In-line pressure sensor fault: common mode out of range	50	The in-line pressure sensor common mode voltage was out of range.	Run Pressure Sensor (In-Line) test.
In-line pressure sensor fault: negative reading	51	The in-line pressure sensor reading was negative.	Run Pressure Sensor (In-Line) test.
Sounder fault	52	No sound could be detected from the primary sounder.	Run Sounder test.
Syringe size sensor faulty	53	The syringe size measured by the syringe size sensor is out of range.	Run Syringe Size Sensor test.
RTC battery fault	54	The battery that maintains the date and time (in the RTC device) is too low.	Check main PCB.
Power supply over voltage	55	Power supply voltage over voltage.	Run Check Voltages test. **Note**: Can result from poor syringe size sensor calibration.
Main PCB supply voltage too high	56	Main board supply voltage too high.	Run Check Voltages test.
Battery needs replacing	57	Main batteries need to be replaced.	Run Battery Current test.
Battery current zero reading out of range	58	Current monitoring system cannot be calibrated (zero reading out of range).	Run Battery Current test.
Inline pressure sensor present sensor fault	66	The inline pressure extension set present sensor present failed its test.	**Note**: Can occur in Check In-Line Sensor test.
PCA handset fault (PCA pump only)	67	PCA handset fault detected.	
Primary processor ADC fault at POST	68	The primary processors analog to digital converters power on test failed.	Run Check ADC Accuracy test.
Secondary processor ADC fault at POST	69	The secondary processors analog to digital converters power on test failed.	Run Check ADC Accuracy test.
Current monitoring system zero fault	70	Current monitoring system zero reading is out of range.	
NV data corruption	71	Corruption of the non-volatile memory has been detected.	

Motor pole position failure	72	The main motor pole position could not be established.	Check main PCB, then motor/ leadscrew and opto sensor.
Clamping arms not open	73	The clamping arms were not open during a syringe load.	Run Sensors and Load/ Unload and Sensors tests.
Motor control error	74	A motor control error has been detected.	Check main PCB, then motor/ leadscrew and opto sensor.
Motor drive error	75	A motor drive error has been detected.	Check main PCB, then motor/ leadscrew and opto sensor.
Pump not calibrated	77	The pump is not calibrated. Please calibrate WSS, DSS and OSSS sensors before use.	Perform calibrations.
Motor Drive Module (POST)	78	The Motor Drive Module has failed its power on self test.	Check main PCB, then motor/ leadscrew and opto sensor.
Software Fault	99	The software reported a run time error. The additional error code allows details of the specific fault to be determined by Smiths Medical International Ltd.	

Figure 3-1 shows the block diagram for the power supply PCB.
The signals on connector JP2 are shown in Figure 1-1 in chapter 1:

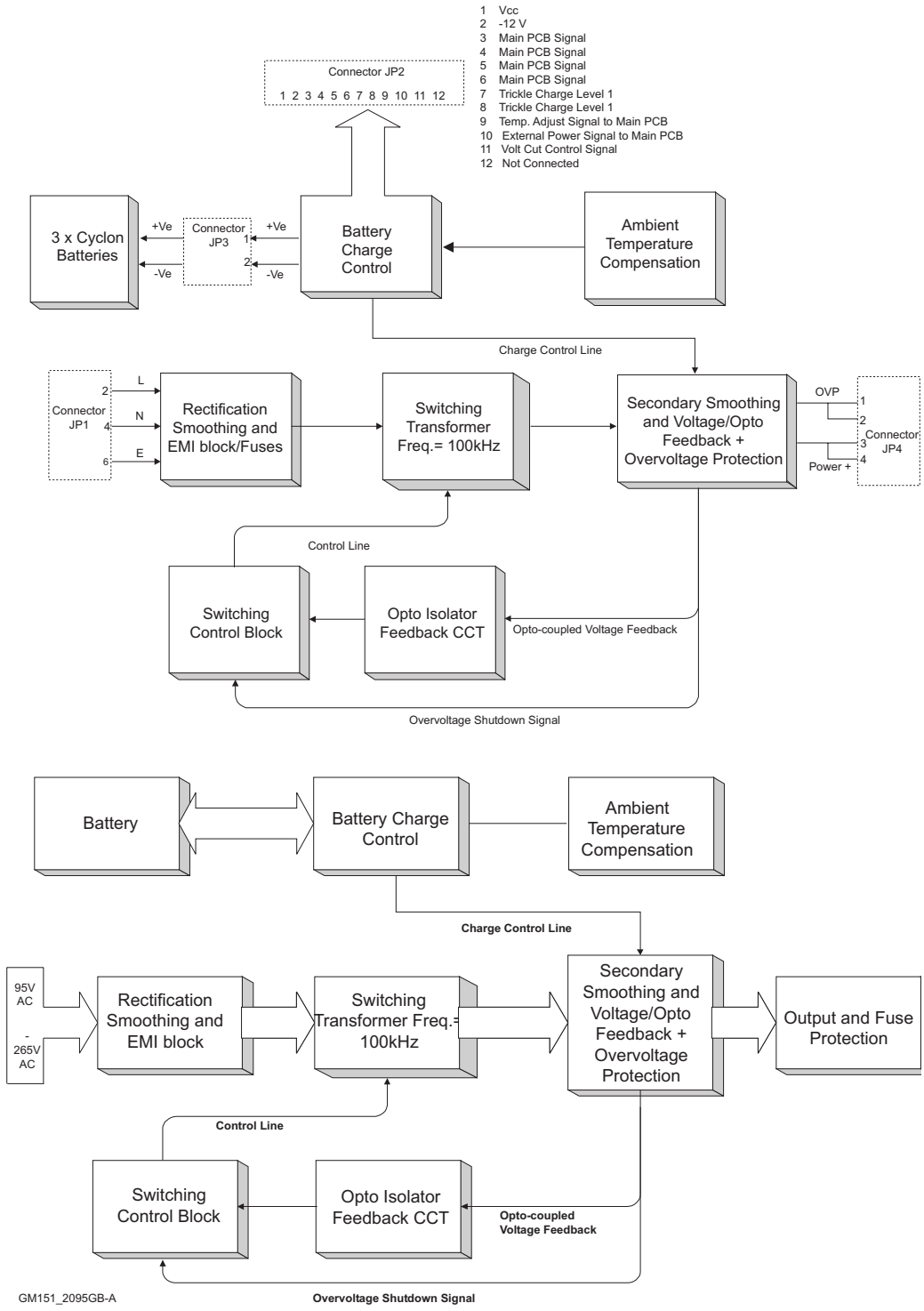


Figure 3-1 Power Supply Unit: Functional Block Diagram

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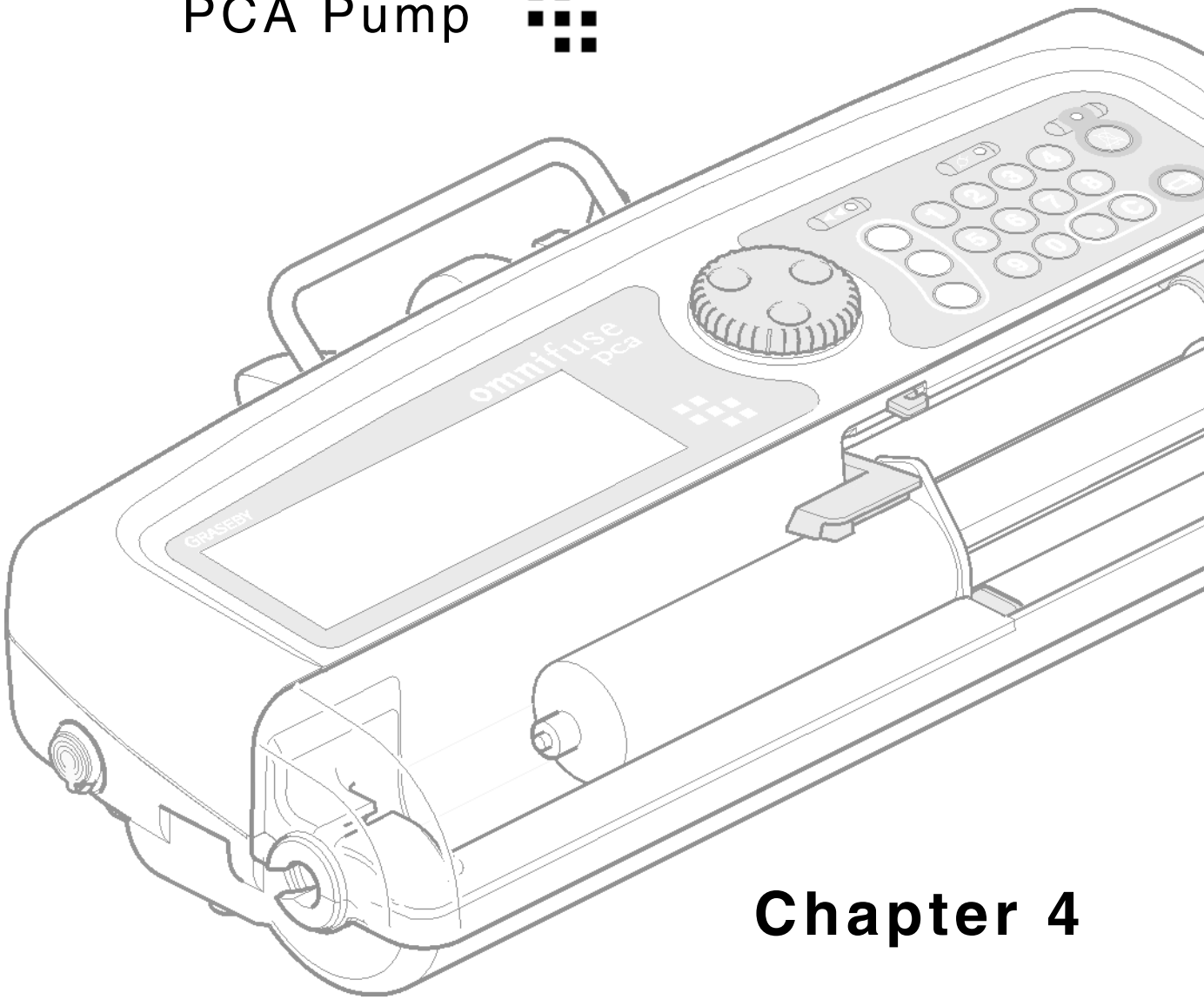
Syringe Pump

PCA Pump



Chapter 4

Disassembly and Reassembly

Chapter 4 – Disassembly and Reassembly

This chapter describes disassembly and reassembly procedures for the Omnifuse™ syringe pump. Details of the internal connections are shown in *Figure 1-1 Omnifuse™ Syinge Pump Internal Connections page 1 - 7*

Tools required

See Chapter 5 - Test and Calibration for a complete list of tools and equipment required to service, test and calibrate the pump.

Parts Replacement

To simplify servicing and ordering parts, some spares are supplied as sub-assemblies rather than as individual items. For example, if a pump keypad fails, a complete new upper case moulding, which includes the keypad, must be ordered.

The following table relates parts to their relevant replacement sub-assemblies:

CAUTION: Replacing the main PCB and installing the lockable cover or in-line sensor as upgrades must only be performed by Smiths Medical International Ltd. Customer Support Engineers as the pump software must also be reconfigured.

Part	Replacement sub-assembly	See
Barrel clamp spring arm*	Barrel clamp spring arm	page 4 - 25
Battery	Three batteries and battery compartment seal	Chapter 2
Carrying handle	Pole clamp	page 4 - 20
Display PCB*	Display PCB	page 4 - 4
Display window*	Upper case (standard or locking)	page 4 - 10 or page 4 - 11
Drive motor and leadscrew*	Pusher drive assembly	page 4 - 22
Drive opto sensor*	Pusher drive assembly	page 4 - 22
Independent Battery Monitor (IBM) PCB*	Independent Battery Monitor (IBM) PCB	page 4 - 4
In-line occlusion sensor*	In-line occlusion sensor	page 4 - 27
Keypad*	Upper case (standard or locking)	page 4 - 10 or page 4 - 11
Lower case*	Lower case	page 4 - 13
Main PCB*	Main PCB (return to Smiths Medical International Ltd.)	
Optical encoder/ command wheel*	Optical encoder/ command wheel	page 4 - 8
Optical interface PCB/ ribbon cable*	Optical interface PCB/ ribbon cable	page 4 - 6
Pole clamp	Pole clamp	page 4 - 20
Pole clamp screw	Pole clamp	page 4 - 20
Pole clamp support frame	Pusher drive assembly	page 4 - 22

Power supply PCB*	Power supply PCB	page 4 - 4
Pusher block*	Pusher drive assembly	page 4 - 22
Pusher drive chassis*	Pusher drive assembly	page 4 - 22
Sounder*	Sounder	page 4 - 9
Syringe barrel clamp*	Pusher drive assembly	page 4 - 22
Syringe cover	Syringe cover	page 4 - 3
Syringe cover lock*	Upper case (locking)	page 4 - 11
Syringe size sensor*	Main PCB (return to Smiths Medical International Ltd.)	page 4 - 4
Syringe size-sensor flag*	Syringe size sensor flag	page 4 - 24
Syringe ear clamp sensor*	Main PCB (return to Smiths Medical International Ltd.)	page 4 - 4
Upper case (locking)*	Upper case (locking)	page 4 - 12
Upper case (standard)*	Upper case (standard)	page 4 - 10

* If this item is fitted, a full test and calibration must be completed using the Omnifuse™ Technician Software, *part number 0151-0266*

Items to be replaced at each disassembly

Note: The battery cover seal must be renewed each time the battery compartment is opened.

These items **may** need renewing:

- Case main seal and tubing.
- Pump calibration label after pump recalibration.

Safety Precautions

The following general safety precautions must be observed when working on the Omnifuse™ syringe pump:

WARNING: Always disconnect the pump from the AC mains supply before opening the case.

WARNING: While working on the pump, be careful not to get your fingers trapped in the pusher drive mechanism. The drive motor is powerful enough for you to be injured by it.

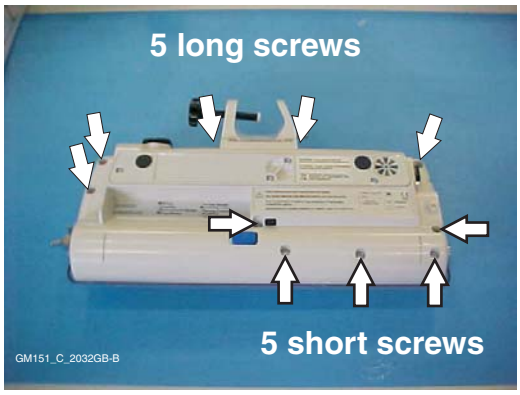
CAUTION: Electro-Static Discharge (ESD) precautions conforming to BSEN 100015-4 (1994) must be strictly observed at all times when removing and handling any pump component. Failure to take such precautions may result in serious damage to the pump and possible malfunction later. An earthing wrist-strap must be worn whenever handling or working near static-sensitive components like printed circuit boards (PCBs). Ensure that any ESD-sensitive components are stored in an anti-static bag or similar container while they are outside the pump.

CAUTION: Loctite 222 adhesive must never be used on the pump since it will damage the case plastic.

Open the pump case

To open the pump case:

1. Switch off the pump and isolate the power.
2. Remove the mains lead retainer (if fitted) and mains lead.
3. If fitted, remove the security cover by carefully prising it from the boss at the right-hand end of the lower case.
4. Lay the pump face-down on a flat, non-scratch surface.
5. Remove and retain the ten M4 screws and washers from the lower case. Note that the five longer screws fit into the rear part of the lower case.



Note: The battery cover need not be removed when opening the case.

6. Hold the case halves together and turn the pump over.
7. Carefully lift the upper case away from the lower case (until clear of the the in-line sensor - if fitted). Lift the syringe barrel clamp and slide the upper case to the left. Ensure that the internal ribbon cables are not damaged.

8. When the upper case is clear of the syringe barrel clamp, swing the upper case towards the pole clamp to disengage it completely from the lower case.
9. Peel off and discard the strip of silicone sealant from the drive casting at the left of the syringe barrel clamp.

Replacing PCBs

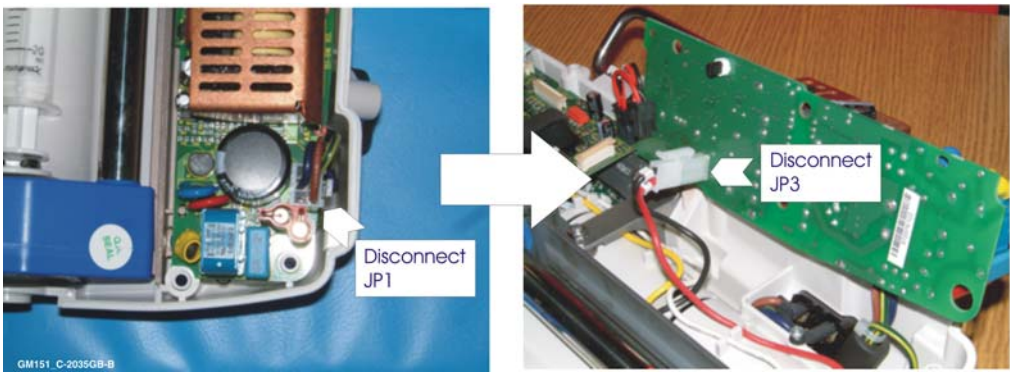
Replacement power supply and display PCBs may be fitted by customers.

A failed main PCB **must** be returned to Smiths Medical International Ltd.

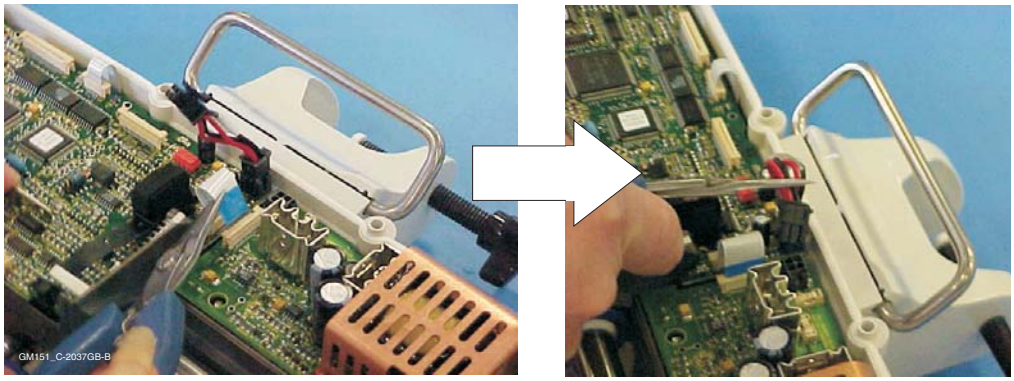
Power supply PCB

If the Omnifuse™ syringe pump power supply PCB fails, it must be renewed (*part number 0151-0568).*

1. Open the case (see *Open the Pump Case,* page 4 - 3).
2. Using an extractor tool, disconnect the ribbon cable and wiring loom between the main and power supply PCBs.
3. Disconnect the AC mains supply loom (JP1) from the top of the PCB. Lift out the PCB and disconnect the battery wiring loom on the underside of the board (JP3).



4. Connect the battery wiring loom to the new PCB (connector JP3) and place the PCB in its recess, locating it over the boss at the rear right-hand corner of the lower case and the dowels on the chassis frame.
5. Connect the mains power loom to the new PCB (connector JP1).
6. Connect the ribbon cable (connector JP2) and the wiring loom (JP4) between the power supply PCB and the main PCB (connectors JP11 and JP12 respectively).

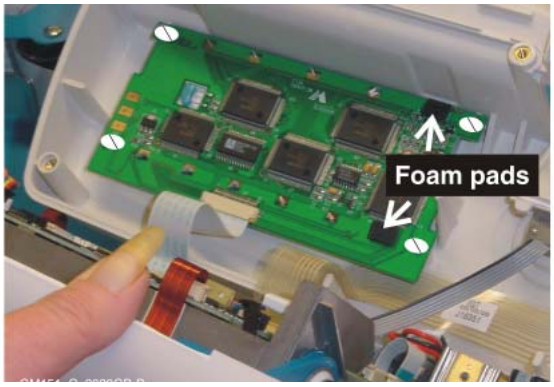


7. Connect the pump to the PC and run the Technician software Check Voltages test (part of Basic Tests).
8. Close the case (see *Close the Pump Case,* page 4 - 29) and run the Battery Current test.
9. Run the remaining Functional and Calibration tests (Chapter 5).

Display PCB

If the display PCB fails, it must be renewed (*part number 0151-0571* - supplied with four 3mm self-tapping screws).

1. Separate the cases (see *Open the Pump Case,* page 4 - 3).
2. Using an extractor tool, disconnect the display, keypad and optical encoder ribbon cables from the main PCB. Retain the lower case.
3. Lay the upper case face down on a level surface and unfasten the four screws and remove the display PCB.
4. Ensure that the two end tabs from the LCD display on the underside of the PCB are flattened and each protected with a black, self-adhesive, foam pad.

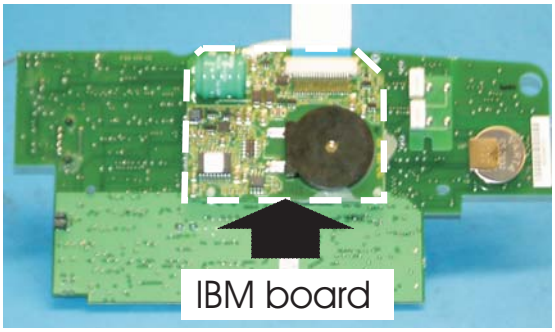


5. Install the new display PCB, securing it with the four self-tapping screws supplied. Tighten the screws to a torque of 40 cNm ± 3.
6. Connect the display PCB (connector JP5), keypad (connector JP2) and optical encoder (connector JP1) ribbon cables to the main PCB.
7. Connect the pump to the PC and run the Technician software Check Keypad and Display test (part of Basic Tests).
8. Close the case (see *Close the Pump Case,* page 4 - 29).
9. Run the Functional and Calibration tests.

Independent Battery Monitor (IBM) PCB

Note: The IBM board is fitted to the Phase 4 and PCA Omnifuse™ syringe pump.

The IBM board is attached to the underside of the main PCB by three locking support posts. Two ribbon cables connect the board to the main PCB (JP5) and the display.



1. Separate the cases (see *Open the Pump Case,* page 4 - 3).

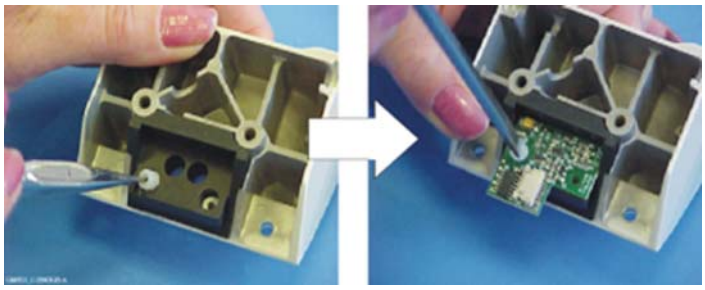
2. Using an extractor tool, disconnect all cables from the main PCB.
   Carefully pull the syringe size sensor flag out through the sensor block.
3. Carefully lift and turn over the main PCB from the case.
4. Disconnect the sounder ribbon cable from the sounder connector board (noting the orientation).
5. Using needle-nosed pliers, squeeze each lock post and lift off the board.
   If necessary, disconnect the ribbon cables from the IBM board.
6. Locate and secure the new IBM board to the main PCB using three lock posts.
7. Connect the sounder ribbon cable to the sounder board on the underside of the main PCB (the shiny contacts face the centre of the pump).
8. Connect the ribbon cable from the IBM board to the main board (JP5).
9. Reposition the main PCB in its recess, locating it over the boss inside the case and the dowels on the drive chassis.
10. Locate the tip of the size sensor flag in the slot in the size sensor block.
    Open the syringe barrel clamp to push it through.
11. Connect the ribbon cables for the optical interface (connector JP9), RS232 (JP13), drive opto-encoder (JP8), motor wiring loom (JP7), PCA (JP10) and flexi cable (JP6).
12. If fitted, connect the in-line sensor (JP3) and PCA (JP10).
13. Connect the board-to-board ribbon cable (connector JP11) and wiring loom (JP12). Connect the LCD display board (connector JP5), keypad (connector JP2) and optical encoder (connector JP1) ribbon cables.
14. Close the case (see *Close the Pump Case*, page 4 - 29).
15. Run the Functional and Calibration tests.

Optical interface PCB

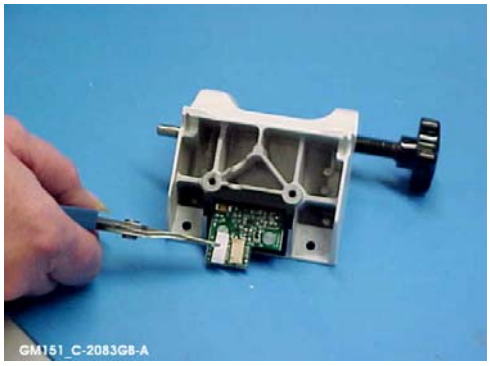
If the optical interface PCB fails, a new part must be fitted (*part number 0151-0574*).

The PCB is supplied with a new seal and two nylon screws and spacers.

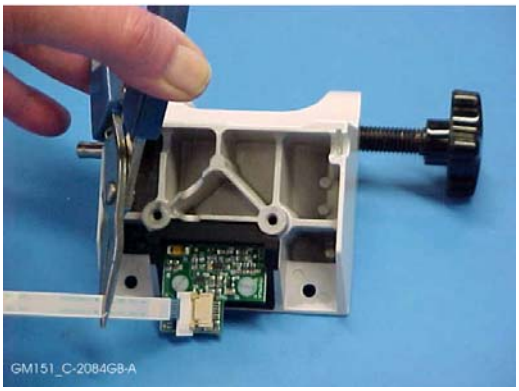
1. Open the pump case (see *Open the Pump Case*, page 4 - 3).
2. Using an extractor tool, disconnect the display, keypad and optical encoder ribbon cables from the main PCB and put the pump upper case aside.
3. Disconnect the ribbon cables and remove the main and power supply PCBs.
4. Unfasten the four screws and remove the latch bar and pole clamp assembly from lower case.
5. Disconnect the ribbon cable from the optical interface PCB and unfasten the two nylon screws. Remove the PCB and seal. Discard the seal.
6. Locate the new optical interface seal in the recess inside the clamp, and fix the PCB in place with the spacers and the two nylon screws. The spacers fit inside the holes in the seal and the PCB fixes on top of them.



7. Fix the white double-sided adhesive pad in place on the on the back of the chip immediately behind ribbon cable connection on the board. Plug the ribbon cable in the connector.



8. Remove the white double-sided adhesive backing paper and press the ribbon cable firmly to it.



9. Using the four M4 screws, fix the pole clamp assembly to the back of the lower case moulding. Two pozi pan screws and shake-proof washers go through the support frame into the pole clamp; two countersunk screws go through the latch bar and pole clamp into the case moulding.

10. Locate the main and power supply PCBs in their recesses and connect the optical interface ribbon cable to the main PCB (connector JP9).

11. Locate the tip of the size sensor flag in the slot in the size sensor block; open the syringe barrel clamp to push it through.

12. Connect the ribbon cables for RS232 interface (connector JP13), drive opto-encoder (JP8), motor wiring loom (JP7) and flexi cable (JP6).

13. If installed, connect the in-line sensor (JP3) and PCA (JP10).

14. Connect the board-to-board ribbon cable (connector JP11) and wiring loom (JP12).
15. Connect the LCD (connector JP5), keypad (connector JP2) and optical encoder (connector JP1) ribbon cables.
16. Close the case (see *Close the Pump Case*, page 4 - 29).
17. Connect the pump to the PC.
18. Using the optical interface testing fixture, run the Technician software Optical Interface test.
19. Run the remaining Functional and Calibration tests (Chapter 5).

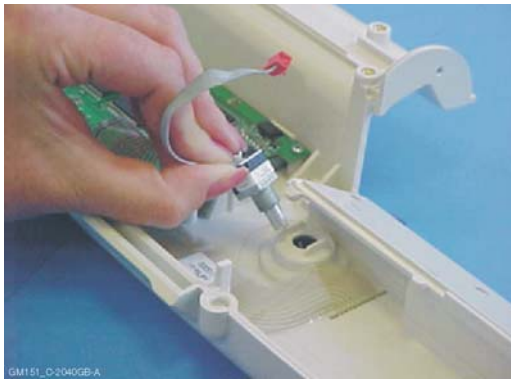
Optical encoder and/ or command wheel

If the optical encoder fails, a new one must be fitted (*part number 0151-0626*).

If the command wheel has been damaged or lost, a new wheel must be fitted (*part number 0151-0635*).

Optical encoder

1. Open the case (see *Open the Pump Case* on page 4 - 3).
2. Using an extractor tool, disconnect the display, keypad and optical encoder ribbon cables from the main PCB. Retain the lower case.
3. Remove the command wheel from the upper case, unfasten the retaining nut and remove the optical encoder.



4. Insert the spindle of the new optical encoder through the hole in the top of the case moulding (ribbon cable facing the front of the pump).
5. Turn the upper case over and fix the encoder in place with the locknut tightened to a torque of 60 cNm ± 5.
6. Push-fit the command wheel onto the optical encoder spindle so that the clip inside the wheel hub engages with the flat on the spindle.
7. Connect the display (connector JP5), keypad (connector JP2) and optical encoder (connector JP1) ribbon cables to the main PCB.
8. Connect the pump to the PC and run the Technician software Check Command Wheel test (part of Basic Tests).
9. Close the case (see *Close the Pump Case*, page 4 - 29).
10. Complete the Functional and Calibration tests (Chapter 5).

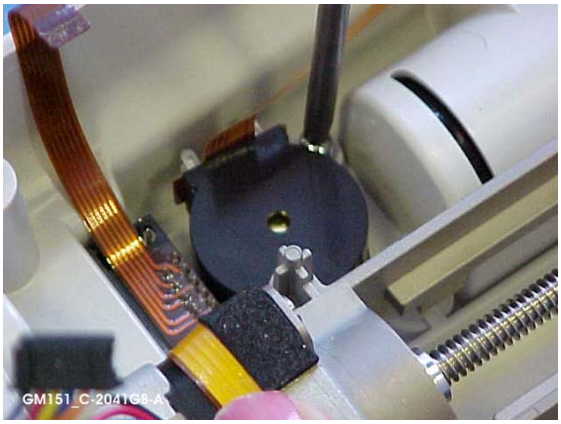
Command wheel

1. Pull the command wheel off the optical encoder spindle.
2. Push-fit the new command wheel onto the optical encoder spindle so that the clip inside the wheel hub engages with the flat on the spindle.
3. Connect the pump to the PC and run the Technician software Check Command Wheel test (part of Basic Tests).

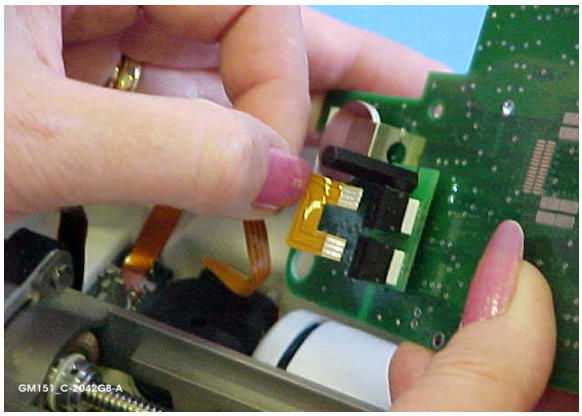
Sounder

If the sounder fails, a new sounder must be fitted (*part number 0151-0661***)**.

1. Open the pump case (see *Open the Pump Case,* page 4 - 3).
2. Using an extractor tool, disconnect all cables from the main PCB. Pull the syringe size sensor flag out through the sensor block and lift out the main PCB.
3. Disconnect the sounder ribbon cable from the connector beneath the main PCB.
4. Unfasten the retaining screw that holds the sounder to the inside of the lower case; lift out the sounder.
5. Locate and secure the new sounder with the M3 screw supplied.



6. Connect the sounder ribbon cable to the underside of the main PCB, pushing it firmly into the connector until it clicks into place.



7. Reposition the main PCB in its recess, locating it over the boss inside the case and the dowels on the drive chassis.
8. Locate the tip of the size sensor flag in the slot in the size sensor block. Open the syringe barrel clamp to push it through.

9. Connect the ribbon cables for the optical interface (connector JP9), RS232 (JP13), drive opto-encoder (JP8), motor wiring loom (JP7), PCA (JP10) and flexi cable (JP6).
10. If fitted, connect the in-line sensor (JP3) and PCA (JP10).
11. Connect the board-to-board ribbon cable (connector JP11) and wiring loom (JP12). Connect the LCD (connector JP5), keypad (connector JP2) and optical encoder (connector JP1) ribbon cables.
12. Close the case (see *Close the Pump Case*, page 4 - 29).
13. Connect the pump to the PC and run the Technician software Calibrate Sounder test (in the **Calibrate** menu).
14. Run the remaining Functional and Calibration tests (Chapter 5).

Keypad

The Omnifuse™ syringe pump keypad is supplied ready-fitted as part of the upper case.
If the keypad fails, a complete upper case must be ordered.

For a standard pump, (i.e. without the locking syringe cover) order *part number 0151-0599*.

If the optional locking syringe cover is fitted, order *part number 0151-0608*.

For a PCA pump, order *part number 0153-0149*.

Upper case (standard version)

The Omnifuse™ syringe pump case is available in two versions: the standard non-locking case and the optional case with a lockable cover.

Replacing a standard upper case moulding involves:

- Separating the pump case halves and removing the display PCB and optical encoder from the original upper case.
- Assembling the replacement upper case.
- Joining the pump case halves.
- Completing the post-reassembly tests listed in the Technician software.

Remove components from the upper case

To separate the pump cases and remove re-usable components from the upper case:

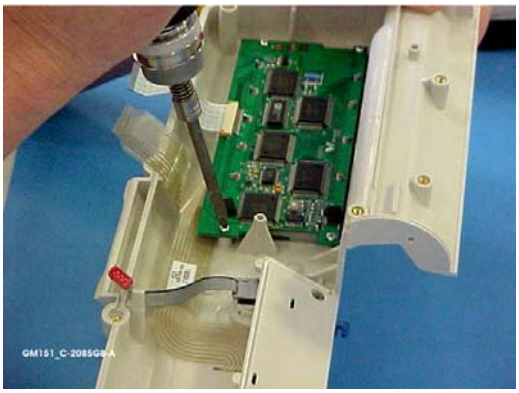
1. Open the pump case (see *Open the Pump Case*, page 4 - 3).
2. Using an extractor tool, disconnect the display, keypad and optical encoder ribbon cables from the main PCB.
3. Pull the command wheel off the spindle, unfasten the retaining nut below it and remove the optical encoder.
4. Unfasten the four self-tapping screws and remove the display PCB.
   Discard the upper case moulding, complete with the keypad membrane and overlay.

Assemble a standard upper case

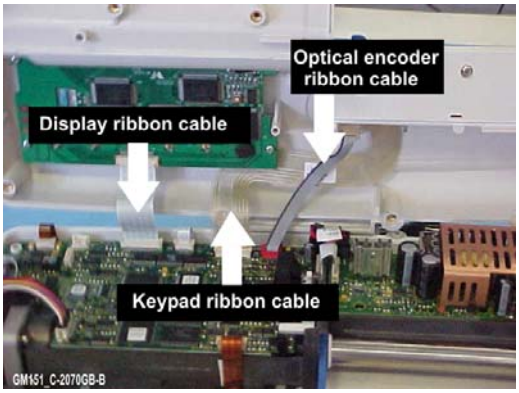
To assemble a standard upper case:

1. Place the upper case moulding face down on a flat, non-scratch surface.

2. Insert the optical encoder spindle through the hole in the top of the case moulding so that the ribbon cable faces the front of the pump.
3. Turn the upper case over and fix the encoder in place with the locknut. Tighten the nut to a torque of 60 cNm ± 5
4. Connect the ribbon cable to the display PCB and fix the PCB to its support pillars using the four 3 mm self-tapping screws.



5. Push the command wheel onto the encoder spindle.
6. Peel the protective film from the display window.
7. Connect the display (connector JP5), optical encoder (connector JP1) and keypad (connector JP2) ribbon cables to the main PCB.



8. Connect the pump to the PC and run the Technician software Check Keypad and Display and Check Command Wheel tests (part of Basic Tests).
9. Close the case (see *Close the Pump Case,* page 4 - 29).
10. Run the Functional and Calibration tests (Chapter 5).

Upper case (locking version)

The locking upper case is an optional feature on the Omnifuse™ syringe pump that can be retrofitted as an upgrade to existing pumps. It may also be replaced if it is damaged.

Upgrade - If a pump is upgraded with a locking upper case, the pump must be returned to Smiths Medical International Ltd. for reconfiguration.

Replace – A damaged locking upper case may be renewed by a service engineer.

The locking upper case is supplied complete with lock mechanism, keypad and display window. A new syringe cover or key must be ordered separately (see Chapter 6 for part numbers).

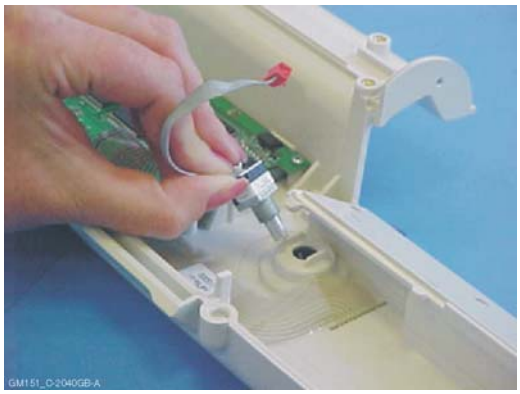
To replace the locking upper case:

- Separate the pump cases and remove the display PCB and optical encoder from the original upper case.
- Assemble the new upper case and join the pump case halves (see *Close the pump case,* page 4 - 29).
- Complete the post-reassembly tests listed in the Technician software.

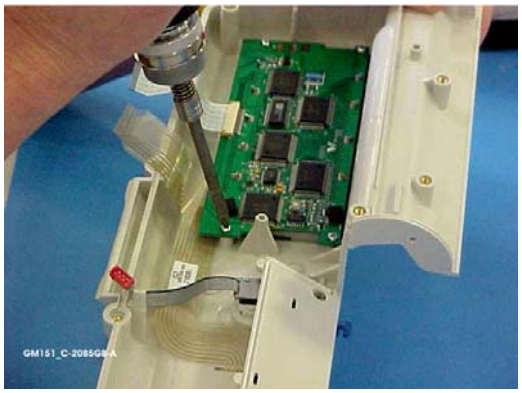
Remove components from a locking upper case

To separate the pump cases and remove re-usable components from the locking upper case:

1. Remove the security cover by carefully prising it from the boss on the right-hand end of the lower case.
2. Open the pump case (see Open the pump case page 4 - 3).



3. Using an extractor tool, disconnect the display, keypad and optical encoder ribbon cables from the main PCB.
4. Pull the command wheel off the spindle. Unfasten the retaining nut below it and remove the optical encoder.
5. Unfasten the four self-tapping screws and remove the display PCB.



6. Discard the original upper case moulding, complete with the lock mechanism and keypad.

Assemble a locking upper case

1. Place the upper case moulding face down on a flat, non-scratch surface.
2. Insert the optical encoder spindle through the hole in the top of the case moulding so that the ribbon cable faces the front of the pump. Turn the upper case over and fix the encoder in place with the lock nut. Tighten the nut to a torque of 60 cNm ± 5.
3. Connect the ribbon cable to the display PCB (connector JP1). Fix the PCB to its support pillars, using the four 3mm self-tapping screws tightened to a torque of 40 cNm ± 3.
4. Push the command wheel onto the encoder spindle.
5. Peel the protective film from the display window.
6. Connect the display (connector JP5), optical encoder (connector JP1) and keypad (connector JP2) ribbon cables to the main PCB.
7. Replace the syringe cover on the pump as follows:
   - Locate the left-hand end of the cover in the hole in the left-hand end of the pump case, and
   - pull the right-hand end of the cover and flex it until it can slide over the small boss on the end of the pump case.
8. Connect the pump to the PC and run the Technician software Check Keypad and Display and Check Command Wheel tests (part of Basic Tests).
9. Close the case (see *Close the Pump Case*, page 4 - 29).
10. Open, close, lock and unlock the security cover a few times to ensure the lock mechanism functions correctly.
11. If the software is configured for a locking case, run the Cover Lock test.

In the pump Configuration menu, set the Lockable Cover parameter to Security, then set up and run an infusion. The pump should:

- display a **COVER UNLOCKED** warning if the infusion is started with the cover open,
- display a **COVER OPEN** alarm if an attempt to open the cover is made while the infusion is running, and
- display a **COVER LOCKED** warning if an attempt to use **BOLUS** or **GRAPH** is made with the cover closed.

12. Run the remaining Functional and Calibration tests (Chapter 5).

Lower case

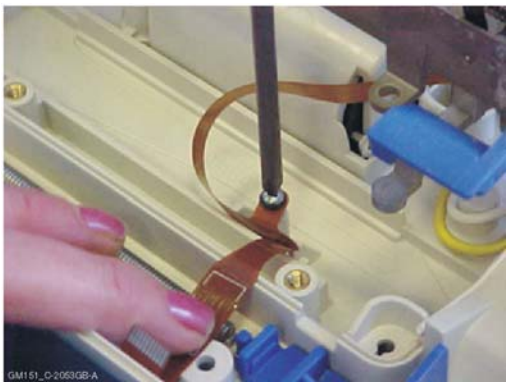
To fit the pump lower case (*part number 0151-0588* or *0153-0150* for PCA pump**)**:

- Separate the pump case and remove the PCBs, batteries, drive assembly, and pole clamp. Note the serial number, manufacture date and configuration details
- Fit the case seal to the rim of the new lower case.
- Assemble the new lower case.
- Print and fix new labels using the Technician software.
- Close the pump case (see *Close the pump case,* page 4 - 29) and complete the tests contained in the Technician software.

Remove components from a lower case

To remove re-usable components from a lower case:

1. Open the pump case (see *Open the Pump Case*, page 4 - 3).
2. Using an extractor tool, disconnect the display (JP5), keypad (JP2) and command wheel ribbon (JP1) cables from the main PCB and put the upper case aside.
3. Disconnect the mains input wiring loom from the power supply PCB (JP1) and lift out the PCB; disconnect the battery wiring plug (JP3).
4. Pull the syringe size sensor flag through the size sensor block.
5. Using an extractor tool, disconnect the ribbon cables from the main PCB and release the board.
6. Disconnect the sounder ribbon cable on the underside of the main PCB.
7. Unfasten two internal pozi pan screws and washers and two external countersunk screws to remove the pole clamp assembly and latching bar.
8. Unfasten the four pozi pan screws and washers securing the chassis *and* the smaller screw and fibre washer which secures the flexible ribbon cable. Remove the pusher drive assembly.



9. Unfasten the two self-tapping screws and fibre flat washers and remove the mains inlet shield.
10. Unfasten the M3 screw and remove the sounder.
11. Unfasten the four battery cover screws and remove the cover. Peel and discard the rubber seal from the inside of the battery cover.
12. Disconnect the wires from the battery terminals and remove the batteries.
13. Remove the battery wiring loom.
14. Release the ear clamp spring from its pillar inside the case moulding and remove the syringe ear clamp.
15. Unfasten the two self-tapping screws and remove the mains input connector. Discard the rubber seal.
16. Remove the in-line occlusion sensor (if fitted).
17. Note the pump SN serial number, Date of Manufacture and configured options from the labels on the original case.
18. Print new labels using the Technician Software and fix them in place.
19. Discard the original lower case, complete with the RS232 connector and PCA cable and clips (PCA only).

Assemble lower case

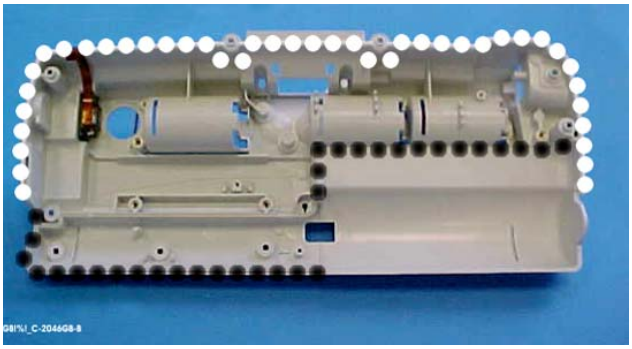
The lower case assembly is supplied with the following parts:

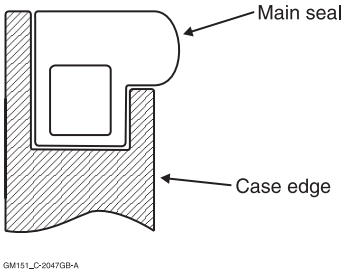
Lower Case Assembly **Standard pump** (side power entry - *part number 0151-0588*) **Standard pump** (rear power entry - *part number 0151-0954*) **PCA pump** (*part number 0153-0150*)	Quantity
Battery cover seal	1
Configuration label	1
Serial number label	
Ear clamp	1
Ear clamp spring	1
Fibre washers	2
Lower case	1
Main case seal	1
Mains connector seal	1
Mains inlet shield	1
RS232 assembly	1
RS232 dust cover	1
RS232 seal	1
Screws: 3 mm self-tapping	2
Foam pad	1
Silicone tubing	1
Cable assembly (*PCA only*)	1
Seal (*PCA only*)	1
Cable clip (*PCA only*)	2

To assemble the lower case:

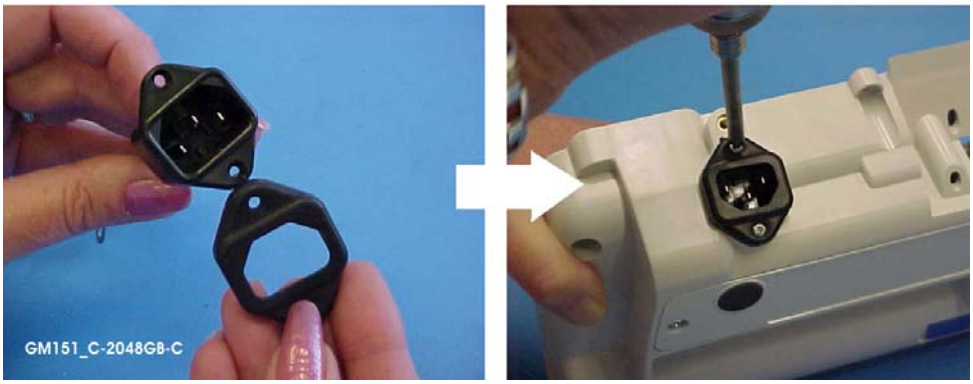
1. Fix the new serial number and configuration labels in place in the recesses on the underside of the lower case.
2. Fix the protective overlays over each label.
3. Using Loctite 406, bond the case main seal in the rim of the lower case moulding (see white dotted line below). The P-section seal fits into the channel around the edge of the moulding.

4. Using Loctite 406, bond the silicone tubing into the two edge recesses (see black dotted line below). Fix one section in place and cut it to length. Use the remainder for the other recess.



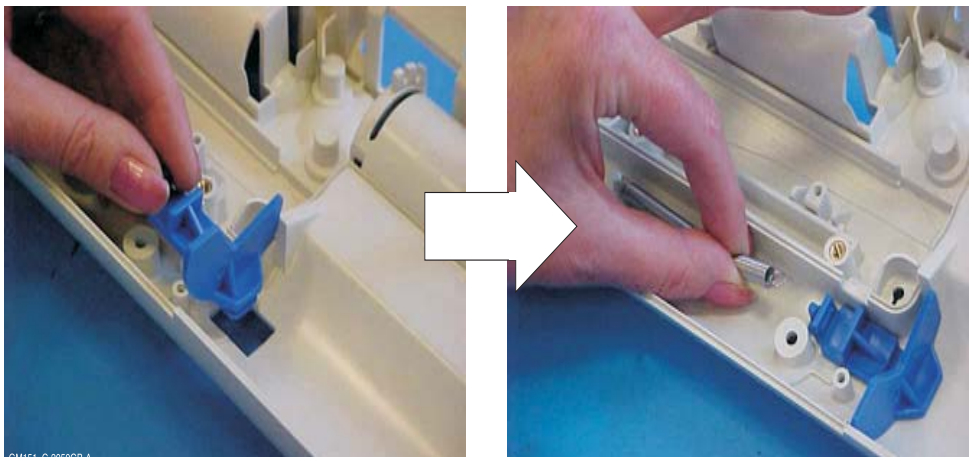


5. Secure the mains input connector into the recess at the rear of the case using the two original self-tapping screws and a new black rubber seal.
Tighten the screws to a torque of 60 cNm ± 5.

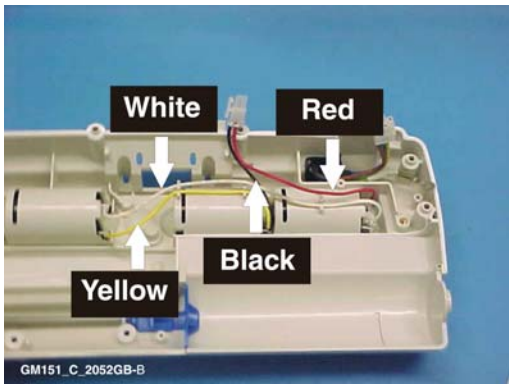


6. Locate the syringe ear clamp in the aperture in the bottom of the lower case moulding.

7. Stretch the spring between the pillar on the case and the stud on the clamp.



8. Push the battery ends of the battery wiring loom through the slots in the three battery compartments. Position the wires in the locating notches as shown below:



9. Peel the backing strip from the battery seal and fix the seal to the inside of the battery cover plate.
Push the battery wiring loom connectors onto the battery with the correct polarity.

Note: Always use a new battery seal as the original seal may have lost some of its elasticity. If re-used, the battery compartment may no longer be watertight.

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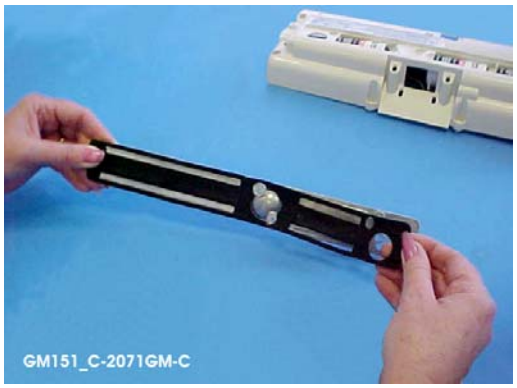
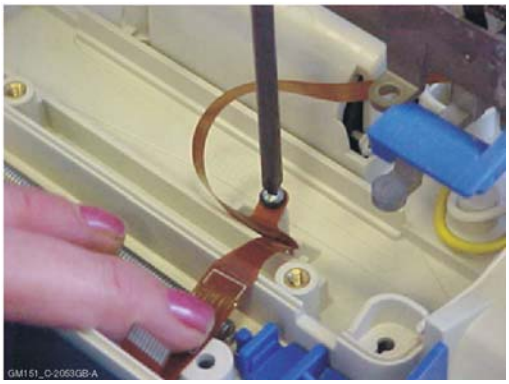
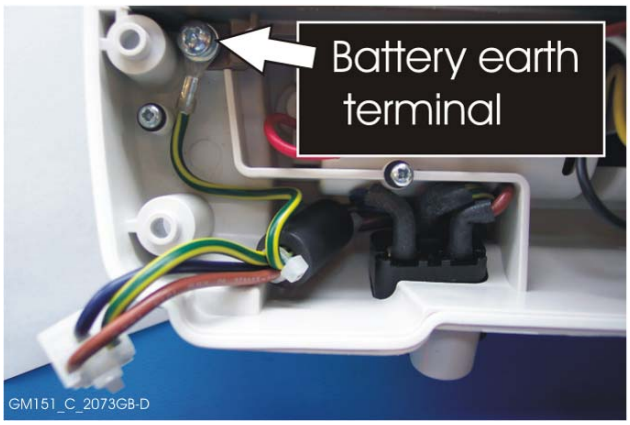


10. Locate the batteries in their compartments as shown. Position and secure the battery cover plate with four M4 retaining screws.

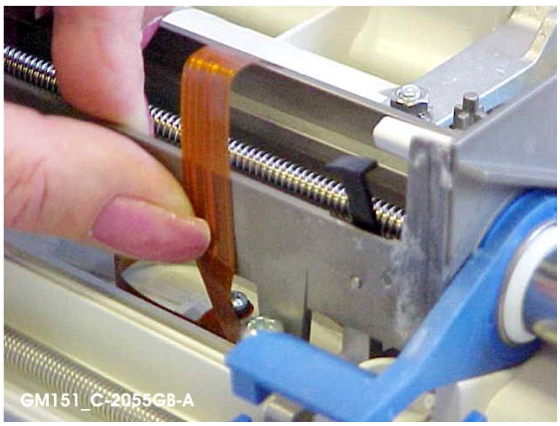
11. Fix the flexible ribbon cable to the support pillar with an M3 self-tapping screw and fibre washer. Ensure that the vertical part of the cable stands up in front of the chassis. Tighten the screw to a torque of 40 cNm ± 3.



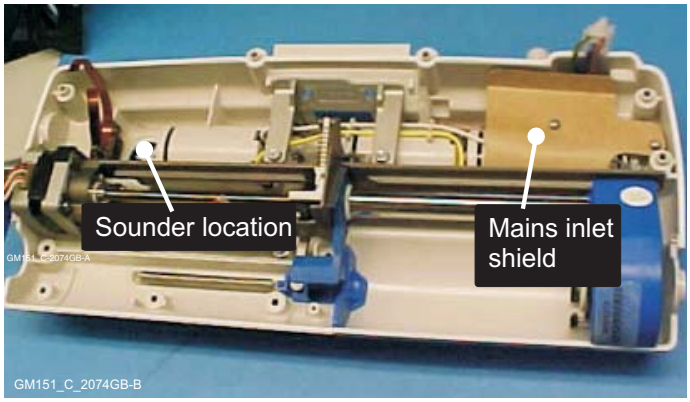
12. Fix the pusher drive chassis to the support pillars inside the lower case using four M4 screws and shake-proof washers. Note that the right hand screw also holds down the battery earth (green and yellow) wire terminal.
Tighten the screws to a torque of 60 cNm ± 5.



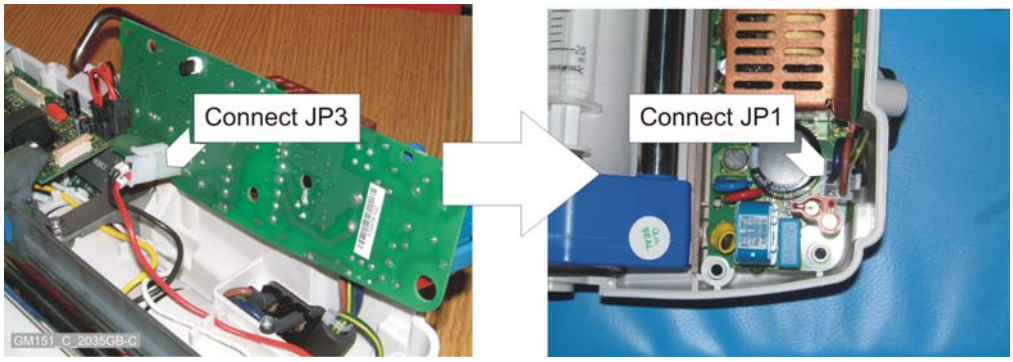
13. Peel the backing paper from the adhesive pad on the flexible ribbon cable and fix it to the side of the chassis.



14. Fix the pole clamp in to the rear of the lower case using the M4 screws, shake-proof washers and latch bar (see *Assemble and secure the pole clamp*, page 4 - 20).



15. Locate the new sounder inside the case and secure it with the retaining screw.
16. Locate and secure the mains inlet shield with two 3 mm self-tapping screws and fibre washers.
    Tighten to a torque of 60 cNm ± 5.
17. Connect the power supply wiring loom to the power supply PCB.
18. Connect the battery and mains input wiring looms to the power supply PCB and locate it in its recess.



19. Locate the main PCB in its recess and connect the board-to-board ribbon cable and wiring loom (connectors JP11 and JP12 respectively).
20. Locate the tip of the size sensor flag in the slot in the size sensor block. Open the syringe barrel clamp to push it through.
21. Connect the ribbon cables for the optical interface (connector JP9), RS232 (JP13), drive opto-encoder (JP8), motor wiring loom (JP7), and flexi-cable (JP6).
22. If fitted, connect the in-line sensor (JP3) and PCA (J10).
23. Connect the LCD (connector JP5), keypad (connector JP2) and optical encoder (connector JP1) ribbon cables.
24. Connect the pump to the PC and run the Technician software Basic suite of tests.
25. Close the case (see *Close the Pump Case*, page 4 - 29).
26. Complete the Functional and Calibration tests.

Pole clamp

The pole clamp may need replacing if the knob has been over-tightened and the clamping screw thread stripped.

To fit a new pole clamp:

- remove the pole clamp and latch bar,
- remove the optical interface PCB from the clamp,
- secure the new pole clamp to the lower case moulding, and
- close the pump case and complete the tests in the Technician software.

The pole clamp (*part number 0151-0631*) includes four M4 fixing screws and optical interface seal. The existing latch bar may be used.

Remove the pole clamp

1. Open the pump case (see *Opening the Pump Case*, page 4 - 3).
2. Disconnect the display, optical encoder and keypad ribbon cables from the main PCB using an extractor tool.
3. Disconnect the optical interface ribbon cable from the main PCB.
4. Remove and retain the main and power supply PCBs.
5. Unfasten four screws and remove the pole clamp assembly from the lower case.
6. Disconnect the ribbon cable from the optical interface PCB.
7. Unfasten two screws and remove the PCB and seal. Discard the seal.

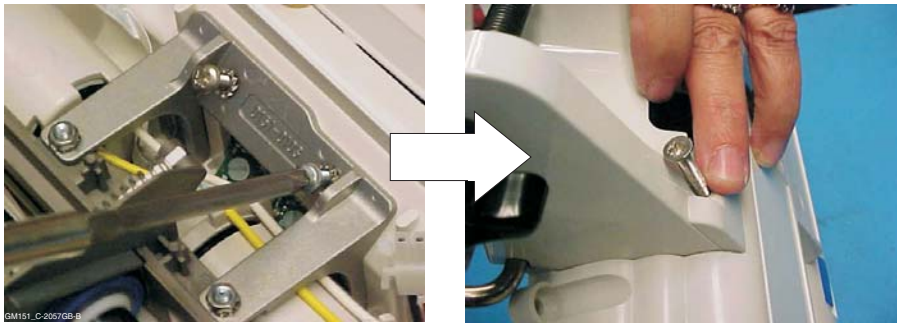
Assemble and secure the pole clamp

To secure a pole clamp:

1. Remove the protective film from the front face of the optical interface window.

   Note: The optical interface will not work if the protective film is not removed.

2. Locate the new optical interface seal in the recess inside the clamp. Locate and fix the PCB in place with the spacers and the two nylon screws. The spacers fit in the holes in the seal and the PCB is fixed on top (page 4 - 6).
3. Connect the optical interface ribbon cable to the PCB (see page 4 - 7).
4. Pass the optical interface ribbon cable through the aperture in the back of the lower case, under the left side of the support frame, and behind and above the main PCB.
5. Fix the pole clamp assembly to the back of the lower case using four M4 screws. Two screws with shake-proof washers go through the support frame inside the case into the pole clamp: two screws go through the latch bar and pole clamp into the pump lower case.



6. Plug the optical interface ribbon cable into the main PCB (connector JP9).
7. Close the case (see *Close the Pump Case*, page 4 - 29).
8. Connect the pump to the PC.
9. Using the optical interface testing fixture, complete the Technician software Optical Interface test.
10. Complete the remaining Functional and Calibration tests (Chapter 5).

Pusher Drive Assembly

The pusher drive assembly (*part number 0151-0578*) must be renewed if:

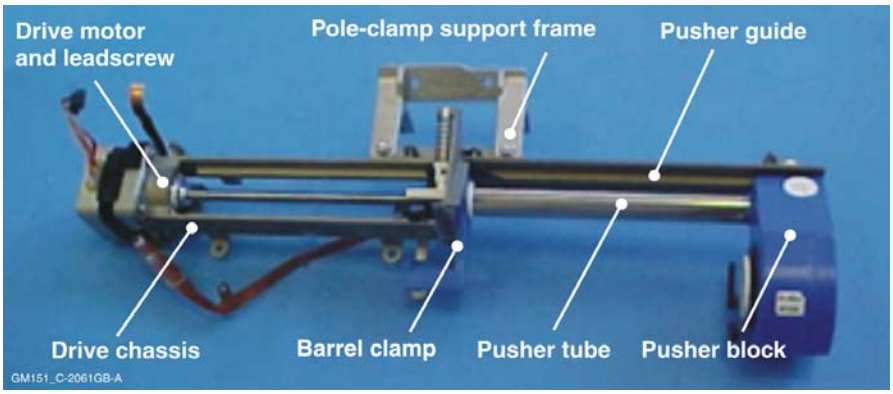
- either the drive motor or leadscrew have failed,
- the drive opto sensor has failed,
- the pusher block is defective, or
- the syringe barrel clamp mechanism is broken.

Pusher drive assembly removal

Open the pump case (see *Open the Pump Case*, page 4 - 3).

1. Using an extractor tool, disconnect all cables from the main PCB. Pull the syringe size sensor flag out through the sensor block and lift the main PCB clear of the case.
2. Disconnect the ribbon cable from the IBM board on the underside of the main PCB.
3. Disconnect the power supply lead from the power supply PCB (JP1) and lift the PCB clear; disconnect the battery plug from the underside of the board.
4. Unscrew the four screws that hold the pole clamp support frame to the lower case (two internal and two external).
5. Unfasten the four retaining screws that hold the drive and frame assembly to the lower case: unscrew the self-tapping ribbon cable retaining screw beneath the leadscrew.
6. Slacken the two M4 hex nuts that hold the drive and frame assembly to the pole clamp support frame.
7. Remove the pusher drive assembly.

Install pusher drive assembly



The Pusher drive assembly comprises

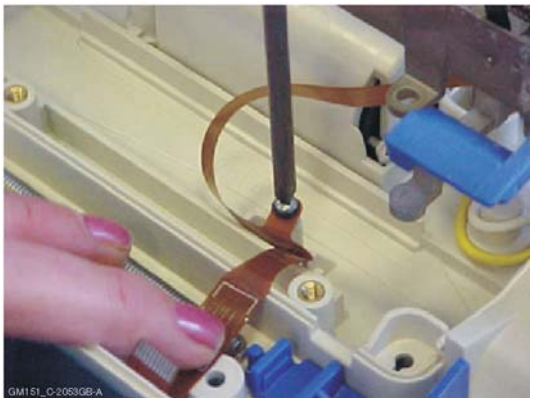
Pusher Drive Assembly (*part number 0151-0578)*	**Quantity**
Pusher drive assembly	1
Screws: M4 pozidrive	4
Washers: M4 shake-proof	4

WARNING: DO NOT ATTEMPT TO REPAIR THE PUSHER BLOCK. Because of the delicate calibration of the internal pressure sensor, the block is supplied as a factory-sealed unit. Any attempt to open it will invalidate the warranty. Using the pump later may produce incorrect infusions, possibly resulting in patient injury or death. If the pusher block malfunctions, always replace the complete pusher drive assembly.

The drive assembly consists of the drive chassis, motor and leadscrew, pusher block and tube, pusher guide, syringe barrel clamp mechanism and pole clamp support frame ready-assembled:

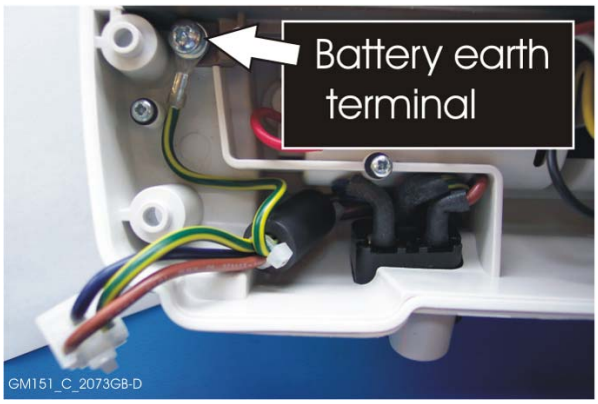
To install the pusher drive assembly in the pump:

1. Fix the flexible ribbon cable to the support pillar using a 3 mm self-tapping screw and fibre washer. Ensure that the vertical part of the cable stands up in front of the chassis. Tighten the screw to a torque of 40 cNm ± 3.



2. Fix the pusher drive chassis to the support pillars inside the lower case using four M4 screws and washers. The right-hand screw also secures the battery earth (green and yellow) wire terminal.

3. Tighten the screws to a torque of 60 cNm ± 5.

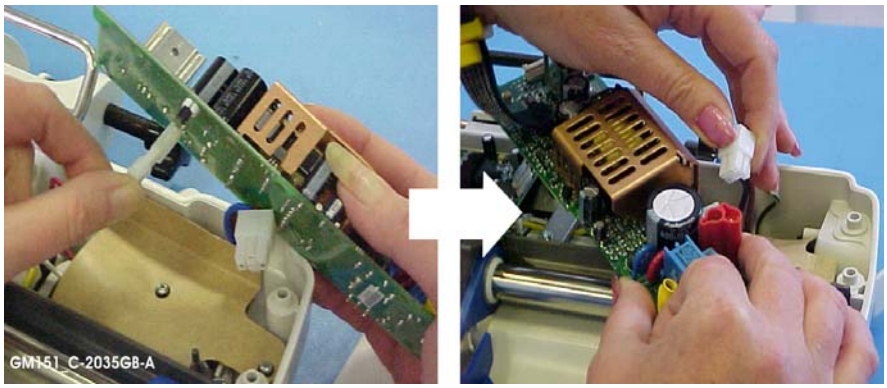


4. If the two M4 nuts have been slackened, tighten each to 60 cNm ± 5.

5. Peel the backing paper from the adhesive pad on the flexible ribbon cable. Fix the cable to the side of the chassis.

6. Connect the sounder ribbon cable to the underside of the main PCB, ensuring that the shiny cable contacts face towards the centre on the pump.

7. Connect the power supply and battery wiring looms to the power supply PCB. Locate the PCB in its recess.



8. Connect the board-to-board ribbon cable (connector JP11) and wiring loom (connector JP12).

9. Locate the tip of the size sensor flag in the slot in the size sensor block. Open the syringe barrel clamp to push it through.
10. Connect the ribbon cables for the optical interface (connector JP9), RS232 (JP13), drive opto-encoder, motor wiring loom (JP7) and flexi cable (JP6).
11. If fitted, connect the in-line sensor (JP3) and the PCA (JP10).
12. Connect the LCD (connector JP5), keypad (connector JP2) and optical encoder (connector JP1) ribbon cables.
13. Connect the pump to the PC and run the Technician software Basic tests.
14. Close the pump case (see *Close the Pump Case*, page 4 - 29).
15. Complete the Functional and Calibration tests (Chapter 5).

Note: If the leadscrew runs jerkily or noisily, apply a smear of silicone grease (Smiths Medical International Ltd. *part number 6835-2006*) to the leadscrew using a cotton bud. Run the screw five times in each direction to spread the lubricant.

If necessary, replace the pusher drive assembly.

Repair the syringe barrel clamp mechanism

The syringe barrel clamp mechanism may need repairing if:

- the syringe size opto sensor flag is broken, or
- the syringe barrel clamping spring arm is broken.

If the barrel clamp is broken or twisted loose from the drive frame, renew the pusher drive assembly.

WARNING: The pump must correctly display the brand and the size of syringe that is going to be used. Using a different brand or size of syringe to that being displayed could lead to the incorrect amount of drug being administered, thus resulting in injury or death to the patient. When a new syringe size sensor flag has been fitted, the pump must be carefully tested using the Technician software and the set of syringe size sensor gauges available from Smiths Medical International Ltd. (*part number 0151-0259*).

Syringe size sensor

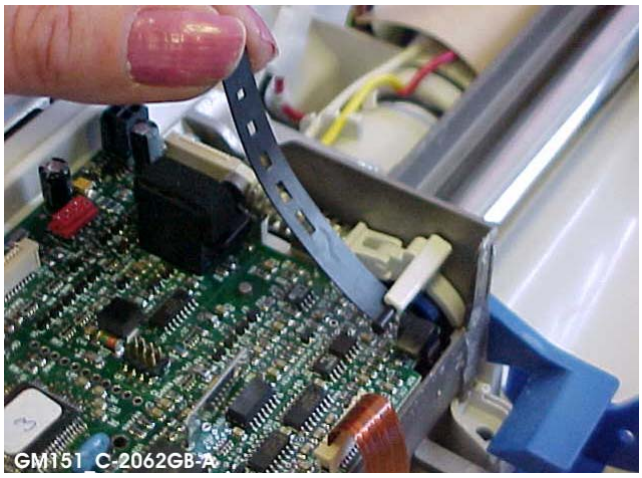
If the syringe size sensor fails, the pump must be returned to Smiths Medical International Ltd.
The sensor is an integral part of the main PCB which will be renewed.

Syringe size sensor flag

If the size sensor flag is broken, it must be renewed. Five sensor flags are included in the Omnifuse™ syringe pump service spares kit.

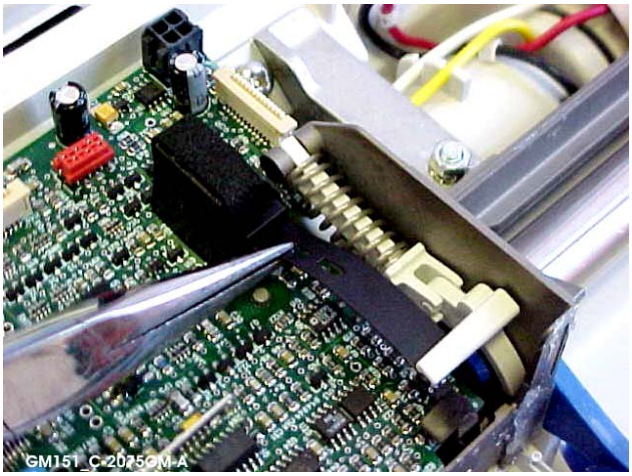
1. Open the case (see *Open the pump case*, page 4 - 3).
2. Close the syringe barrel clamp.

3. Slide the rolled end of the sensor flag from the slot in the quadrant arm, and pull the flag through the opto sensor block.



4. Slide the rolled end of the new sensor flag into the slot in the quadrant arm.

5. Insert the tip of the sensor flag into the opto sensor block. Open the barrel clamp and push the flag through the block.



6. Connect the pump to the PC and run the Technician software Check Syringe Size Sensor test (part of Basic Tests).

7. Close the case (see *Close the pump case* page 4 - 29).

8. Run the Size Sensor test using the syringe size gauges.

9. Run the remaining Functional and Calibration tests.

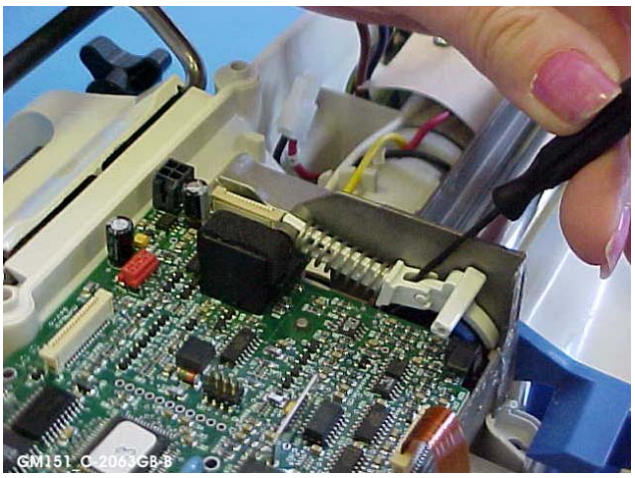
Barrel clamp spring arm

A broken barrel clamp spring arm must be renewed. Five clamping spring arms are included in the Omnifuse™ syringe pump service spares kit.

1. Open the case (see *Opening the pump case,* page 4 - 4).

2. Close the barrel clamp.

3. Taking care not to damage the PCB or the size sensor flag, insert a small screwdriver between the jaws of the clamp arm pivot end and lever the arm free of the two lugs on the quadrant.



4. Remove the spring from the damaged arm and place it over the new one.

5. With the jaws of the fork pointing upwards, locate the fork end of the spring arm over the lug on the chassis. Push it up to the spring's limit of compression.
6. Press the pivot end of the spring arm until the jaws snap into place over the two lugs on the quadrant.
7. Connect the pump to the PC and run the Technician software Check Syringe Size Sensor test (part of Basic Tests).
8. Close the case (see *Close Pump Case*, page 4 - 29).
9. Using the syringe size gauges, complete the Size Sensor test.
10. Run the remaining Functional and Calibration tests (Chapter 5).

Syringe ear clamp sensor

The syringe ear clamp sensor mechanism may need renewing in whole or in part if:

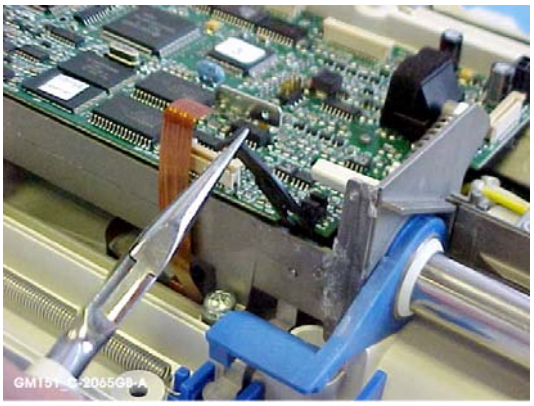
- the ear clamp opto sensor has failed, or
- the ear clamp sensor flag has broken or come loose.

The ear clamp opto sensor is part of the main PCB. If the sensor fails, the main PCB must be renewed by Smiths Medical International Ltd.

Replace the ear clamp sensor flag

To renew the sensor flag, the pump case must be opened. Five flags are included in the service spares kit. Testing and calibration is completed after reassembly (Chapter 5).

1. Open the case (see *Open the Pump Case,* page 4 - 3).
2. Pull the ear clamp sensor flag off the pivot pin in the side of the drive chassis.
3. Push the jaws of the new flag over the pivot pin so that the flag snaps into place with its jaws enclosing the lug on the ear clamp activating arm.



4. Close the case (see *Closing the Pump Case,* page 4 - 29).
5. Connect the pump to the PC and run the Technician software Sensors test.
6. Complete the remaining Functional and Calibration tests.

In-line occlusion sensor (replacement only)

The in-line occlusion sensor is an optional feature and can be retrofitted as an upgrade to an existing pump. It should be renewed if it is damaged or becomes inaccurate.

Upgrade - To upgrade a pump to feature an in-line sensor locking upper case, the pump must be returned to Smiths Medical International Ltd. where the pump's software will be reconfigured to recognise the new option.

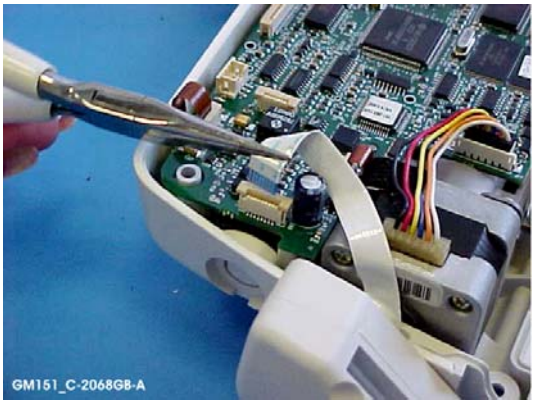
Replace - A damaged in-line sensor may be renewed by the customer.

The in-line sensor (*part number 0151-0615*) is supplied with an M3 countersink screw and a black captive washer.

1. Open the pump case (see *Open the Pump Case,* page 4 - 3).
2. Disconnect the in-line sensor ribbon cable from the main PCB using an extractor tool.
3. Turn the lower case over and unfasten the retaining screw with washer and remove the defective in-line sensor, pulling the ribbon cable out through the slot in the lower case.
4. Thread the new sensor ribbon cable through the slot and up past the left-hand edge of the main PCB.

5. Locate the in-line sensor's retaining lug over the boss on the lower case.
6. Fix the sensor in place with the screw and captive washer.

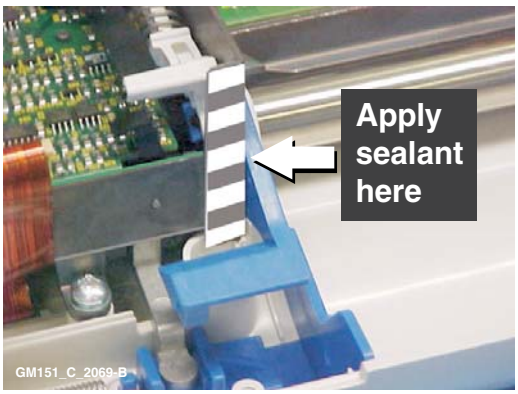
7. Turn the lower case over and connect the sensor ribbon cable to the main PCB (connector JP3).



8. Connect the pump to the PC. Run the Technician software Check In-Line Sensor test using a disposable.
9. Close the pump case (see *Close the Pump Case*, page 4 - 29).
10. Call up the Configuration menu and set the In-line Pressure Sensing feature to Enabled.
11. Complete the Pressure Sensor, In-Line and In-Line Pressure tests using the pneumatic transducer tester and a disposable.
12. Complete the remaining Functional and Calibration tests (Chapter 5).

Close the pump case

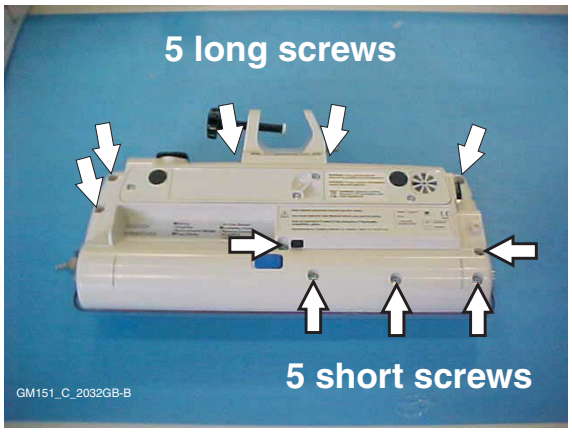
1. Ensure that leads and ribbon cables are neatly positioned and free from twists, chafing or traps.
2. Apply a drop of RTV3145 silicone sealant to the end of a flexible spatula (4 mm wide).
3. Smear the sealant evenly along the surface of the drive chassis below the syringe clamp arm (see diagram). The sealant sets in approximately 30 minutes.



If the case halves have not been joined in this time and the sealant has set, it must be pealed off and a new seal applied.

Avoid excess sealant which must be removed before it sets. Sealant between the case and the syringe clamp could impair movement of the spring-loaded clamping arm.

4. Place the rear edge of the upper case against the rear edge of the lower case near the pole clamp.
5. Swing the upper case downwards and move it to the right, taking care not to trap or damage the ribbon cables.
6. Lift the syringe clamp to about its halfway position and continue to slide the upper case right until the screw holes line up.
7. Holding the halves of the case together, turn the pump over and place it on a flat, non-scratch surface.
8. Fix the case halves together using the ten original M4 screws and washers, noting that the five longer ones go towards the rear of the pump.
   Tighten the screws to a torque of 60 cNm ± 5.

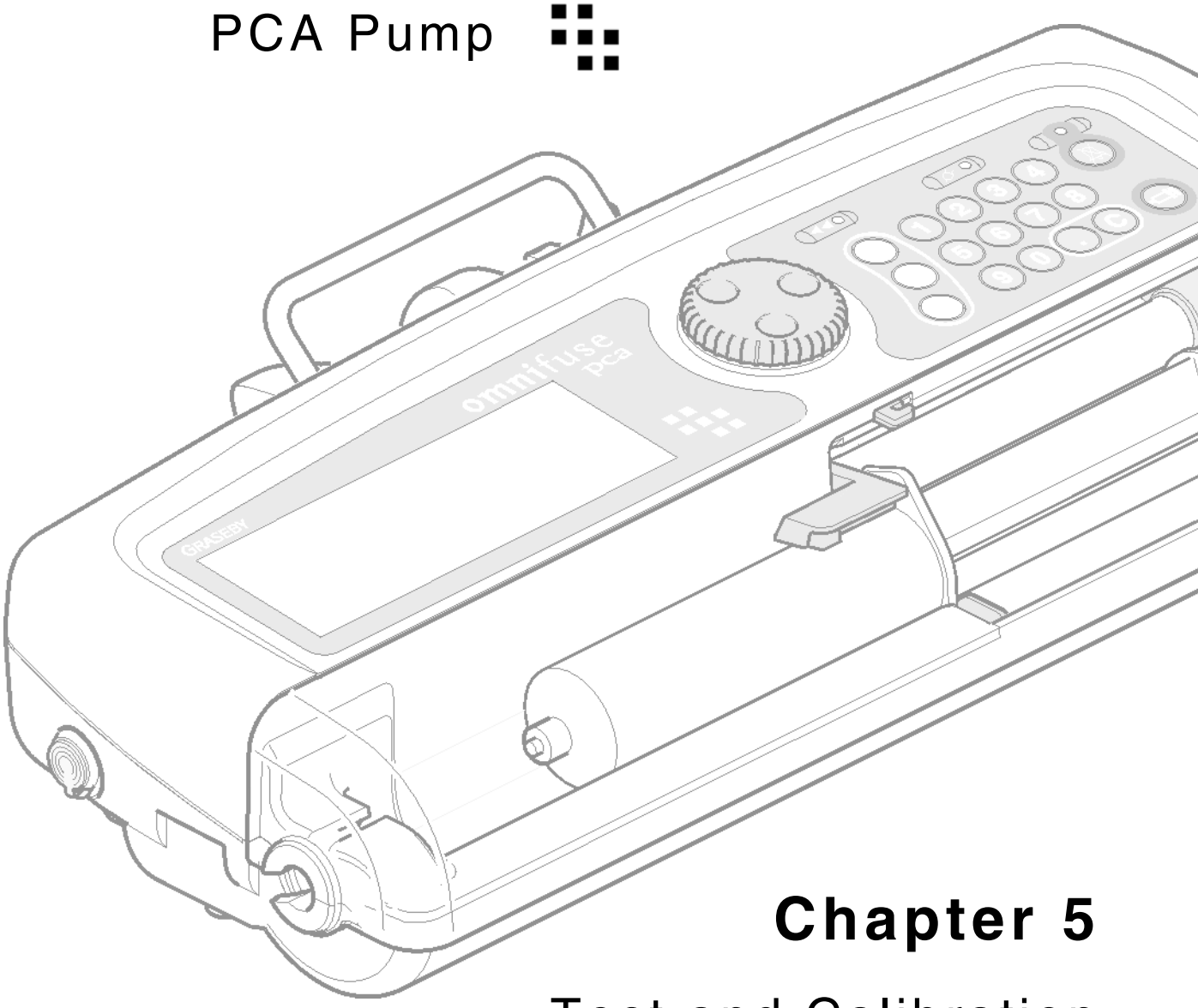


9. If the mains cable retaining clip was fitted, resecure in place.
10. Connect the pump to the PC and complete the Technician software Functional and Calibration tests.

omnifuse™

Syringe Pump

PCA Pump



Chapter 5

Test and Calibration

Chapter 5 – Test and Calibration

This chapter summarises the tests and calibration procedures that may be accessed from the *Omnifuse™ Technician Software* loaded on a PC.
The software enables a Service Engineer to test and calibrate a pump after service and/or repair. It contains the complete suite of on-line test and calibration routines, with error-code interpretations and a comprehensive system of Help screens.

Note: When connected to a PC, the correct RS232 cable, *part number 0053-0738* ONLY may be used.

Test sequence

The Technician software contains Basic, Functional and Calibration tests. Tests may be run either individually or as a complete sequence.

WARNING: The Technician software tests can be run either individually, in any order to isolate and correct a specific fault, or as a complete suite. If the pump case is opened for any reason, the warranty agreement with Smiths Medical International Ltd. may be automatically invalidated. Failure to run *all* Functional and Calibration tests after closing the pump case may result in incorrect operation, leading to inaccurate infusions which may cause injury or death to patients.

The test sequence is outlined below. For details of each test, see *Test and Calibration Procedures*, see page 5 - 6.

Basic tests

Most of these tests require access to test points on the main and power supply PCBs, and must be performed with the pump case open. When the case is closed, the Functional and Calibration tests must be run.

- Check voltages.
- Check ADC accuracy.
- Check syringe size sensor.
- Check command wheel.
- Check keypad and display.
- Check in-line sensor.
- Check PCA handset.
- Check optical interface.
- Check Independent Battery Monitor (IBM) board.

Functional tests

These tests are run with the pump case closed. Select **Test** on the *Omnifuse™ Technician Software* for details of each test. The tests can be performed either individually, or as a suite in the following order:

- Check battery current.
- Check sensors.
- Check load and unload sequence and sensors.
- Occlusion sensing (in-line).
- Occlusion sensing (dry-side).
- Check sounders.
- Check PCA handset.
- Check cover lock.

- Check optical interface.
- Check pressure sense (dry-side).
- Check pressure sense (in-line).
- Rate test.

Calibration tests

The Calibration tests must be performed with the pump case closed. The tests can be performed either individually or as a suite in the order shown. Select **Calibrate** on the *Omnifuse™ Technician Software* for details of each test.

- Calibrate syringe size sensor.
- Calibrate pressure sensor (dry-side).
- Calibrate pressure sensor (in-line).
- Calibrate sounder.

Logging repairs and part replacement

When logged onto the *Omnifuse™ Technician Software*, a Repair screen, which gives service information may be accessed.

The Repair screen is displayed when the application is first opened. From this, either the Repair Log for an attached pump or a previously stored Repair Log can be shown.

If a critical component is renewed, its serial number must be recorded.

Critical parts

The following critical parts of the Omnifuse™ syringe pump are listed in the *Omnifuse™ Technician Software*:

- Pusher drive assembly (including the syringe ear clamp sensor and the syringe size sensor) part number 0151-0578.
- Power supply PCB, part number 0151-0568.
- Main PCB (replaceable only by Smiths Medical International Ltd. Customer Support Engineers).
- In-line sensor (if installed), part number 0151-0615.
- Independent Battery Monitor (IBM) board, part number 0151-0088.

If any of these parts are changed, the new serial number must be entered in the **Log Replacement of PCBs and Critical Parts for pump xxxxxxxx** dialog box (accessed via **Change / Replace Part...** on the menu bar of the *Omnifuse™ Technician Software*). This ensures that a complete service record for each pump is maintained.

Critical parts are supplied with their serial number.
After installation, complete steps (1) to (5) for each changed part.

1. Open the *Omnifuse™ Technician PC Software*.
2. Enter your name in the **Please enter your name** dialog box and click on **OK**.
   - If you have the *pump connected*, click on **Attach Pump and Get Log**.
   - If the *pump is not connected* and a Repair Log already exists, either enter the 8-digit serial number in the **Serial Number:** box, or select the serial number from the drop down list. Click on **Select Serial No. and Get Log**.
3. Select **Change / Replace part...** on the *Omnifuse™ Technician Software* menu bar. The **Log replacement of PCBs and Critical Parts for pump xxxxxxxx** dialog box is displayed.
4. Enter all the required information. On-screen prompts advise of incorrect formats.

Click on **OK** to save the data. An Information screen reminds you to repeat all tests.

5. The new information is presented as the next data line on the opening window of the Technician PC Software.
   It shows the Date, Time, Operator, Description, Details and Data.

6. To print a hard copy of the Repair Log, click on **Open** at the bottom of the screen.
   Enter the **Serial:** number of the pump when prompted and click on **Open**.
   A complete, easy to read Repair Log for the pump is displayed.
   If required, it may be printed.

Test procedures flowchart

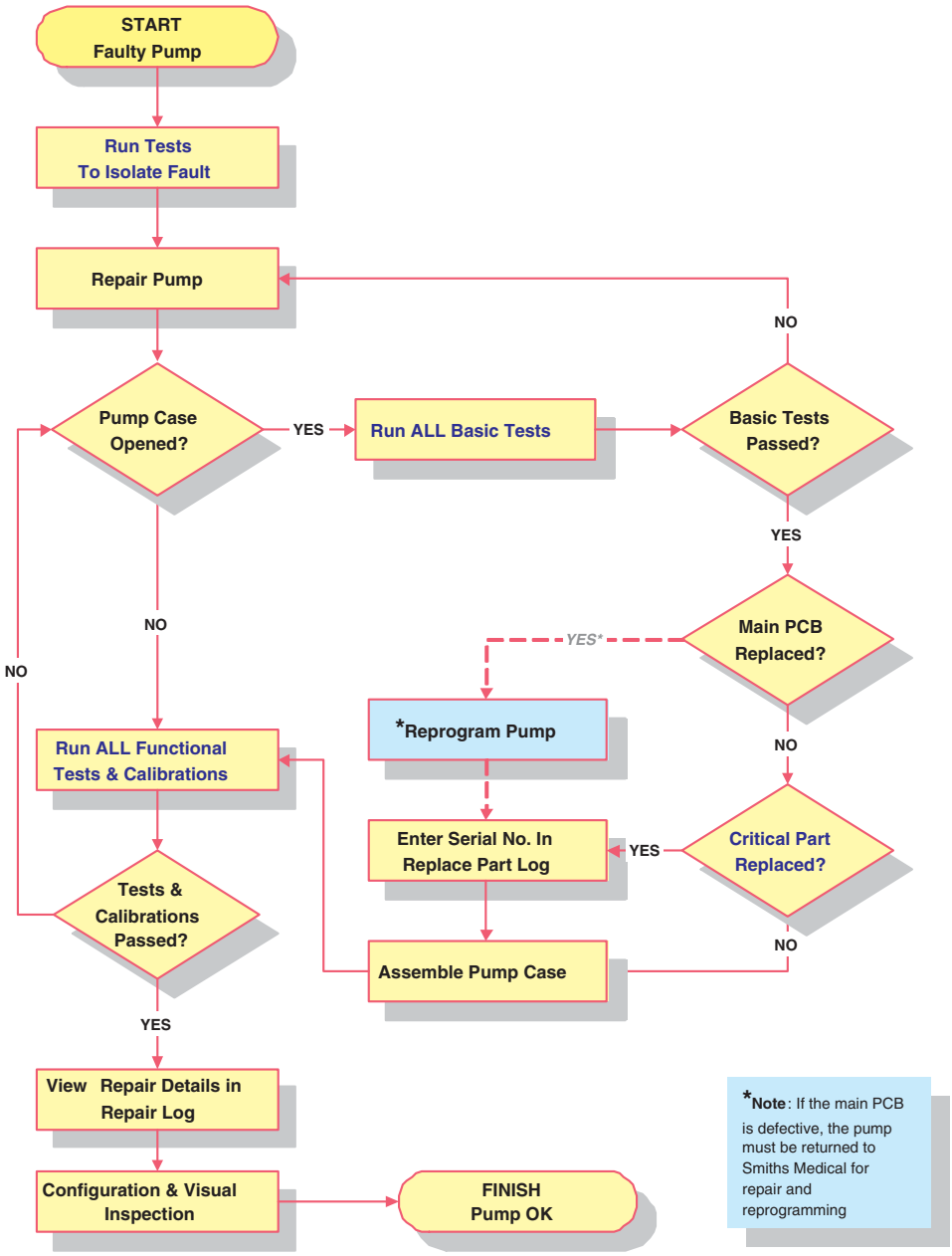


Figure 5-1 Post-repair test and calibration flowchart

Figure 5-1 shows the process that must be completed whenever the pump is repaired or the pump case opened.

The flowchart must be followed after running the post-reassembly test suite in order to check that everything required has been completed.

CAUTION: If the main PCB is renewed, the pump must be reprogrammed. This can only be done by Smiths Medical service engineers at the Repair Centre.

Test Equipment

The following equipment is required for testing and calibrating the Omnifuse™ syringe pump:

Item	Part Number or Type
PC: Pentium 100MHz or above with at least 32 Mb of RAM, RS232 interface and printer. Must be running Windows 95™ or later (see *Omnifuse™ Technician Software* booklet supplied with the CD ROM for details).	--
Omnifuse™ Technician Software CD-ROM	0151-0266
Digital multimeter	Fluke 79 111
Sound level meter (analog)	Castle GA206
60 MHz Oscilloscope	Tektronix TDS210 or similar
Optical checking fixture	Part of Service Spares Kit (0151-0658)
Occlusion set-point indicator (FMS GM74-564): matched and calibrated with set-point transducer below (jointly known as 'the Load Cell' for test purposes).	0151-0287
Occlusion set-point transducer (FMS GM74-565): matched and calibrated with set-point indicator above (jointly known as the 'Load Cell' for test purposes).	
Syringe size-gauge set: 8 mm, 12 mm, 13 mm, 14 mm, 21 mm, 25 mm and 35 mm	0151-0259
Pneumatic transducer tester	Dale20. Bio-Tek® DPM-1B
Philips screwdriver No. 1	--
Philips screwdriver No. 2	--
Screwdriver, flat-blade 4 mm x 150 mm	--
Torque screwdriver: adjustable 20 – 100 cNm	--
T10 torx driver (right-angled)	--
4 mm AF socket with appropriate driver	--
11 mm AF socket with appropriate driver (deep)	--
Pliers, small	--
Connector inserter/ extractor tool	--
2/ 5 ml, 20 ml, 50 ml disposable syringe (any brand)	--
Flo-Safer™ disposable extension set with in-line pressure sensing disc.	0130-0041

Test and Calibration Procedures

When the Omnifuse™ syringe pump has been serviced/ repaired and before the case halves are closed:

1. Run all the Basic tests (see page 5 - 1).
2. If the pump passes all the Basic tests, close the pump case (see Chapter 4, *Disassembly and Reassembly*).
3. If the sounder has been replaced, run the Calibrate sounder function.
4. Run the Calibration functions (see page 5 - 2).
5. Run all the Functional tests. If the pump passes all the tests, certify the pump as fully tested and calibrated.
6. If any critical part is renewed, record the serial numbers in the Repair Log (see page 5 - 2).
7. Ensure that the Test Procedures flowchart (page 5 - 4) sequence is complete.
8. If all procedures have been successfully performed, certify that the pump is fit for use.
9. Print-out the test results and file them with the pump documentation.

For further details, refer to the Help screens in the *Omnifuse™ Technician Software*.

Basic tests

The Basic tests can be run individually. To access test points, the tests nearly always require the pump case halves to be separated. If so, all the Basic, Functional and Calibration tests must have successfully completed for the warranty to remain valid.

Note: The Check Keypad and Display test can be run with the pump case closed. To adjust brightness or contrast, the pump case must be opened to access the relevant potentiometer. Alternatively, the brightness and contrast can be adjusted using the Display Brightness and Display Contrast in the pump Configuration menu (refer to the *Technical User Manual*).

Functional tests

Test	Purpose	Equipment Required
Check Voltages	Checks that input (Vin), power supply (-12 V DC) and ADC reference (Vref) voltages are within limits.	Calibrated DVM
Check ADC Accuracy	Checks that ADC reference voltage (primary Vcc and secondary Vcc) is within tolerance.	Calibrated DVM
Check Syringe Size Sensor	Checks that syringe size sensor is working correctly.	None
Check Command Wheel	Checks that optical encoder works correctly (turn wheel clockwise/ anticlockwise; press/ release wheel).	None

Check Keypad and Display	Checks operation of self-test sequence, LEDs, screen brightness/ contrast and correct detection of key presses. **Note**: In some circumstances this test can be run without opening the pump case.	None
Check In-Line Sensor	Checks that the in-line occlusion sensor (if installed) can detect the sensor disc.	Disposable

The following tests check the correct working of the pump after repair and when the case has been closed.
If repairs have been carried out - or the pump case opened without anything else having been done - the warranty is automatically invalidated until the tests and the calibrations below have been successfully completed.

Test	Purpose	Equipment Required
Battery Current	Tests battery current and detects imminent battery failure.	None
Sensors	Checks functioning of: • First-touch sensor. • End-of-travel sensor. • Ear-clamp sensor. • Arms-open sensor.	None
Load/ Unload Sensors	Checks syringe load and unload sequences and reaction of sensors.	50 ml syringe
Occlusion Sensing, In-Line	Checks that an in-line occlusion pressure is detected (Only applicable if in-line sensor option is installed).	Pneumatic transducer tester and disposable
Occlusion Sensing, Dry-Side	For standard occlusion sensing, checks that a pressure is detected.	Calibrated and zeroed load cell
Sounder	Checks functioning of sounder during power-up.	None
Handset	Checks the functionality of the PCA handset (if fitted).	None
Cover Lock	Checks that pump can detect when cover is closed, and that cover lock is working.	None
Optical Interface	Checks optical interface.	Optical checking fixture
Pressure Sensor, Dry-Side	For standard occlusion sensing, checks that a specific pressure value can be detected (only applicable if in-line sensor option is not installed).	Load cell (already calibrated and zeroed)
Pressure Sensor, In-Line	Checks that a specific in-line occlusion pressure value can be detected (Only applicable if in-line sensor option is installed).	Pneumatic transducer tester and disposable
Rate Test	Checks that infusion is at approximately the programmed flow rate.	50 ml syringe

Calibration tests

The Basic and Functional tests check whether a particular function is working. The Calibration tests check a particular function and calibrate it correctly.

Test	Purpose	Equipment Required
Size Sensor	Checks and calibrates the syringe size sensor.	Syringe size gauges
Dry-Side Pressure	Checks and calibrates the standard occlusion pressure sensor (only applicable if in-line sensor option is not installed).	Calibrated and zeroed load cell
In-Line Pressure	Checks and calibrates the in-line pressure sensor (only applicable if in-line sensor option is installed).	Pneumatic transducer tester and disposable
Calibrate Sounder	Checks that the sounder is working and allows you to adjust its frequency to give optimum sound.	Sound-level meter

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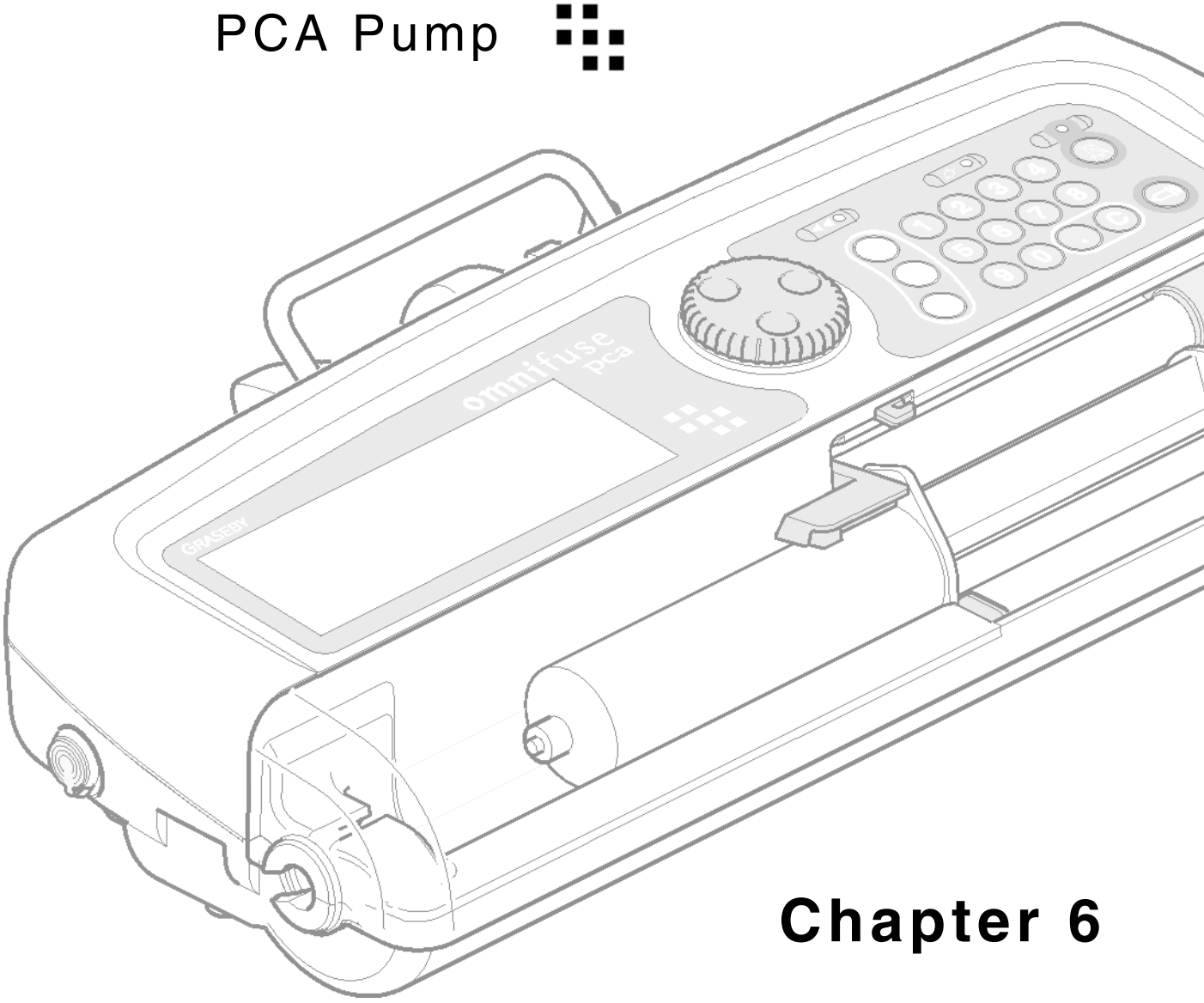
Syringe Pump

PCA Pump



Chapter 6

Parts List

Chapter 6 – Parts Lists

This chapter lists sub-assemblies and individual parts required for service and repair. *Figure 6-1* identifies each sub-assembly or part.

Note: If the case is opened, the Omnifuse™ Technician Software *(part number 0151-0266)* is essential to complete calibration and testing.

Supply of Spare Parts

To simplify ordering and supply, most spares are available as part of a sub-assembly rather than an individual component. e.g. if a new locking upper case for the pump is ordered, the case moulding, complete with assembled lock mechanism, keypad and display window will be supplied.

In addition to the various replacement sub-assemblies and individual parts, a Service Spares Kit is available. The boxed kit contains a standard set of small components and fixings for the Omnifuse™ syringe pump, see page 6 - 9.

If the Lower case assembly is changed, new labels *must* be prepared and fitted. Use the blank labels provided and follow the print label instructions in the Omnifuse™ Technician Software *(part number 0151-0266)*. This ensures that the serial number, date of manufacture and installed options are correctly displayed on the pump. If the labels cannot be printed locally, fax the label information and delivery address to the Smiths Medical Repair Centre on **+44 (0) 1923 475900** where new labels can be printed and returned.

For details of fitting, testing and calibrating spare parts, refer to Chapter 4.

Main PCB

If the main PCB is defective, it must be returned to Smiths Medical for repair and software reconfiguration.

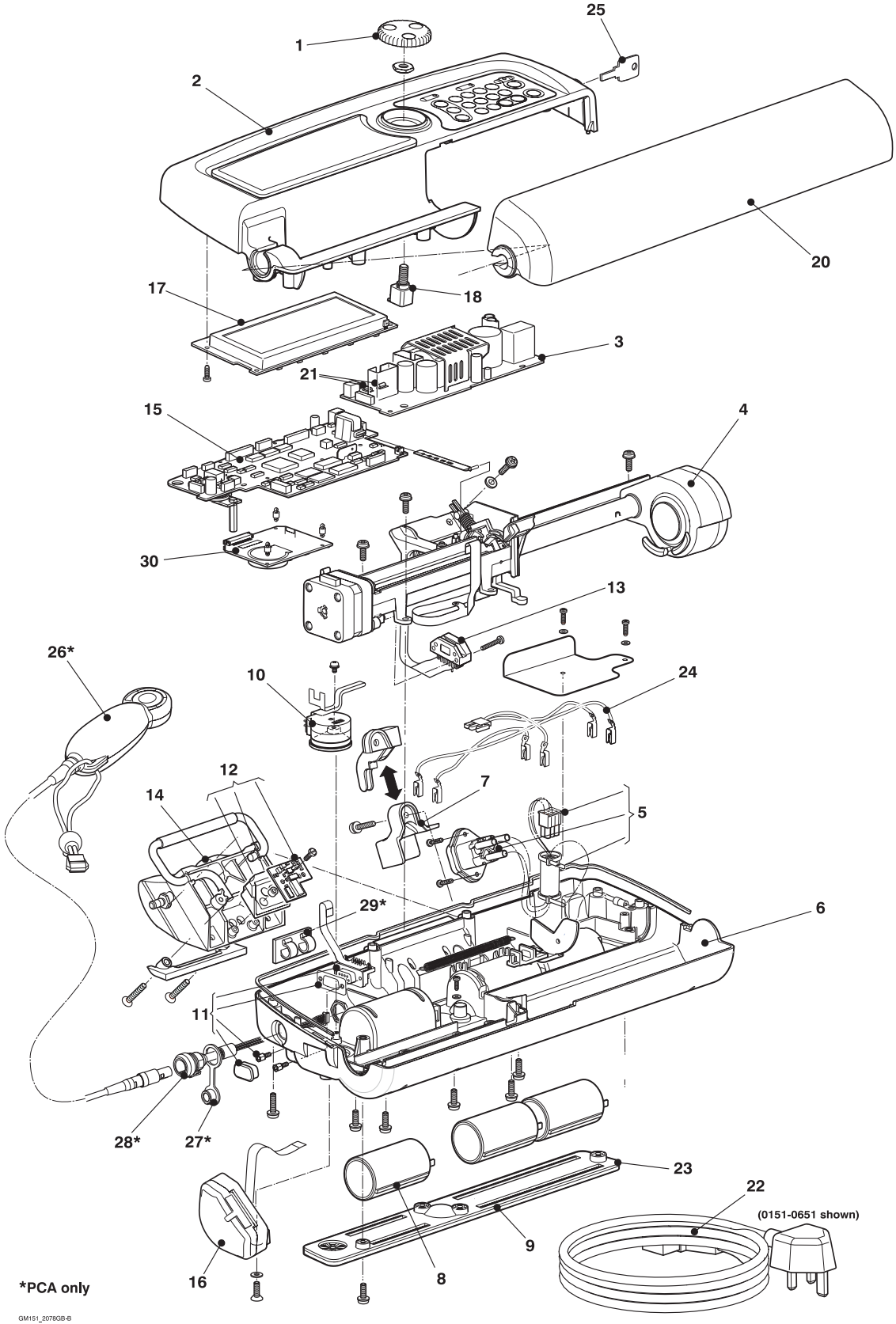


Figure 6-1 Omnifuse™ Syringe Pump Spares

Refer to Figure 6-1 to locate and identify a part.

Item	Description	Part No.	No. off
1	Command Wheel, Omnifuse™ syringe pump (green)	0151-0635	1
	Command Wheel, Omnifuse™ syringe pump PCA (purple)	0153-0148	1
2	Case Assembly, Omnifuse™ syringe pump, Upper (standard)	0151-0599	1
	[1]Case Assembly, Omnifuse™ syringe pump, Upper (locking)	0151-0608	
	Case Assembly, Omnifuse™ syringe pump, PCA, upper	0153-0149	1
3	PCB, Power Supply Unit	0151-0568	1
4	Pusher Drive and Frame Assembly	0151-0578	1
5	Mains Input Connector, comprising:-	0151-0591	1
	Mains input connector		1
	Seal, mains input connector		1
	Screw, M2, self-tap		2
6	Case Assembly, Omnifuse™ syringe pump, Lower, right hand side mains entry[2]	0151-0588	1
	Case Assembly, Omnifuse™ syringe pump, Lower, rear mains entry (not illustrated)[2]	0151-0954	1
	Case Assembly, Omnifuse™ syringe pump, PCA, Lower, comprising:-	0153-0150	1
	Lower case		1
	RS232 dust cover		1
	Seal, main case		1
	Seal, mains connector		1
	Ear clamp		1
	Seal, battery cover		1
	Mains inlet shield		1
	Washer, fibre		2
	Screw, 3 mm, self-tap		2
	Silicone tubing		1
	Spring, ear clamp		1
	Label, configuration		1
	Overlay, configuration label		1
	Label, serial number		1
	Overlay, serial number label		1

7	Retainer, Mains Lead (side entry)	0151-0655	1
	Retainer, Mains Lead (rear entry)	0151-0846	1
	Retainer, Mains Lead (USA/Canada/Australia only)	0151-0858	
8	Battery (three required)	0151-0649	1
9	Cover, Battery	0151-0618	1
10	Sounder, comprising:-	0151-0661	1
	Sounder		1
	Screw, M3, pozidrive		1
11	Connector, RS232, comprising:-	0151-0594	1
	RS232 connector		1
	Seal, RS232 connector		1
	Dust cover, RS232		1
	Screw, D-connector		2
12	PCB, Optical Interface, comprising:-	0151-0574	1
	Optical interface PCB		1
	Optical interface seal		1
	Spacer		2
	Screw, M3, nylon		2
13	Motor Opto Kit, comprising:-	0151-0624	1
	Motor opto assembly		1
	Screw, M2, pan head		2
14	Pole Clamp Assembly, comprising:-	0151-0631	1
	Pole clamp		1
	Latching bar,		1
	Screw, M4, pozidrive		2
	Washer, M4, shake-proof		2
	Screw, M4, countersunk		2
15	[1]PCB, Main, Omnifuse™ syringe pump	-	1
	[1]PCB, Main, Omnifuse™ syringe pump, PCA	-	1
16	[3]In-line Occlusion Sensor, comprising:-	0151-0615	1
	In-line occulsion sensor		1
	Washer, captive		1
	Screw, M3, countersunk		1

17	PCB, Display, comprising:- PCB, display Screw, 3 mm, self-tap	0151-0571	1 1 4
18	Optical Encoder Kit	0151-0626	1
19	Ribbon Cable Set (not illustrated) , comprising:- Ribbon cable, optical interface Ribbon cable, main PCB/ PSU Wiring loom, board to board	0151-0628	- 5 5 5
20	Cover, syringe	0151-0633	1
21	Fuse	0151-0647	10
22	Mains lead Mains lead (European, right-angled) Mains lead (Australian) Mains lead (Swiss) Mains lead (North American)	0151-0651 0151-0176 0151-0178 0151-0324 0151-0177	1
23	Seal, battery	0151-0653	5
24	Cable loom, battery	0151-0645	1
25	Key	0151-0641	1
26	Handset Assembly (Omnifuse™ syringe pump, PCA only)	0153-0146	1
27	PCA seal (Omnifuse™ syringe pump, PCA only)	0153-0147	1
28	Cable Assembly, internal (Omnifuse™ syringe pump, PCA only)	0153-0151	1
29	Clip (Omnifuse™ syringe pump, PCA only)	0153-0152	2
30	IBM (Independent Battery Monitor) board assembly	0153-0088	1

[1] If defective, this item must be returned to Smiths Medical for repair and software reconfiguration.

[2] The labels in the Lower case assembly kit can be printed using the Omnifuse™ Technician Software *(part number 0151-0266).*

[3] If this item is fitted new as an upgrade, the pump must be returned to Smiths Medical for software reconfiguration.

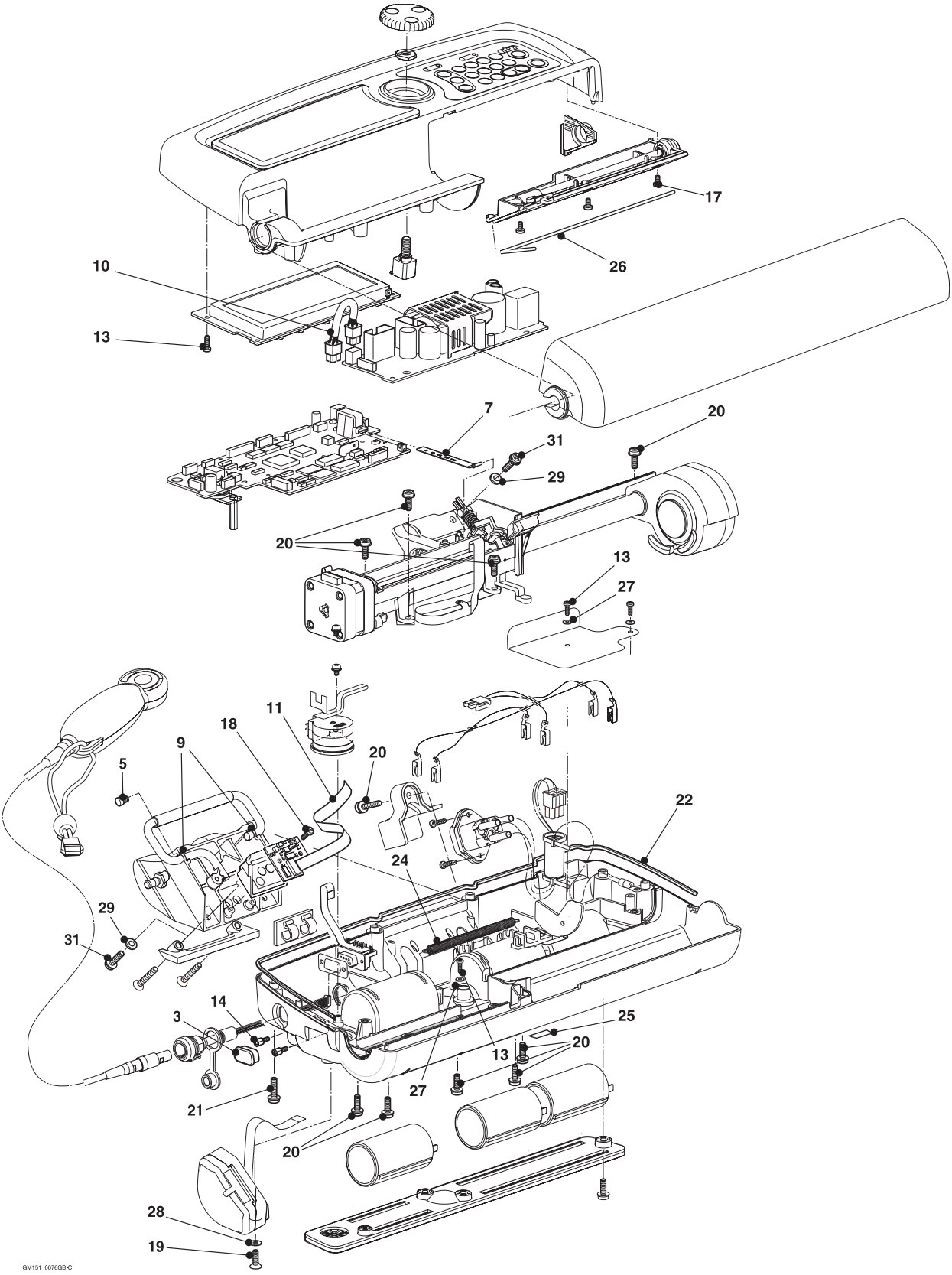


Figure 6-2a Omnifuse™ Syringe Pump Service Spares Kit

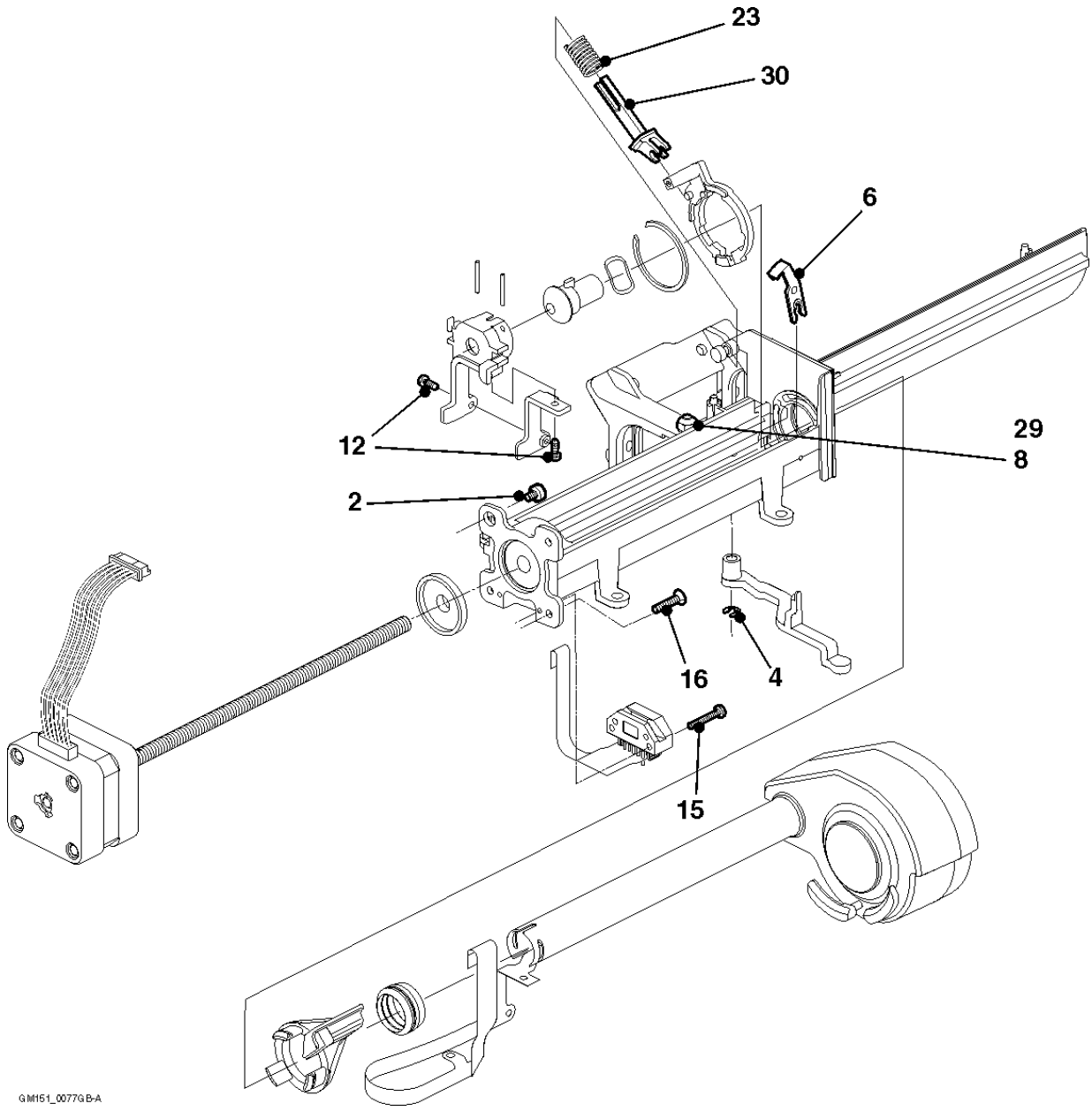


Figure 6-2b Omnifuse™ Syringe Pump Service Spares Kit (continued)

Service spares kit

The Service Spares Kit contains the following items that are used during service and repair. The items are supplied in a boxed kit, *part number 0151-0658*. Refer to Figures 6-2a/b to locate and identify a part.

Item	Service Spares Kit *(part number 0151- 0658)* Description	No. off
1	Checking fixture, optical interface (not illustrated)	1
2	Dowel, motor location	2
3	Dust cover, RS232	10
4	E-clip	5
5	End knob, pole clamp screw	10
6	Flag, ear clamp sensor	5
7	Flag, syringe sensor size	5
8	Nut, M4 , hexagonal, stainless steel	5
9	O-ring, carrying handle	10
10	Cable, main PCB to PSU	5
11	Ribbon cable, optical interface	3
12	Screw, 2.5 mm x 7, self-tap, pozidrive, stainless steel	10
13	Screw, 3 mm x 10, self-tap, pozidrive, stainless steel	10
14	Screw, D-connector, RS232	6
15	Screw, M2.5 x 16, pan head, pozidrive, stainless steel	10
16	Screw, M3 x 6, cap head, stainless steel	6
17	Screw, M3 x 6, pan head, pozidrive, stainless steel	10
18	Screw, M3 x 10, pan head, slotted, nylon	10
19	Screw, M3 x 8, countersunk, pozidrive, stainless steel	5
20	Screw, M4 x 12, flat washer, spring washer, pozidrive, stainless steel	10
21	Screw, M4 x 16, flat washer, spring washer, pozidrive, stainless steel	10
22	Seal, main, 48 cm	10
23	Spring, ear clamp	5
24	Spring, syringe barrel clamp	5
25	Stop, lockable cover	10
26	Tubing, silicone, 48 cm (not shown on drawing)	10
27	Washer, fibre	10
28	Washer, M3, captive	5
29	Washer, M4, shake-proof, stainless steel	5
30	Spring arm, clamping	5
31	Screw, M4 x 16, pan head, stainless steel	10

Software

Item	Part No.
Omnifuse™ syringe pump Technician PC software	0151-0266
Omnifuse™ Protocol Management System software	0153-0084

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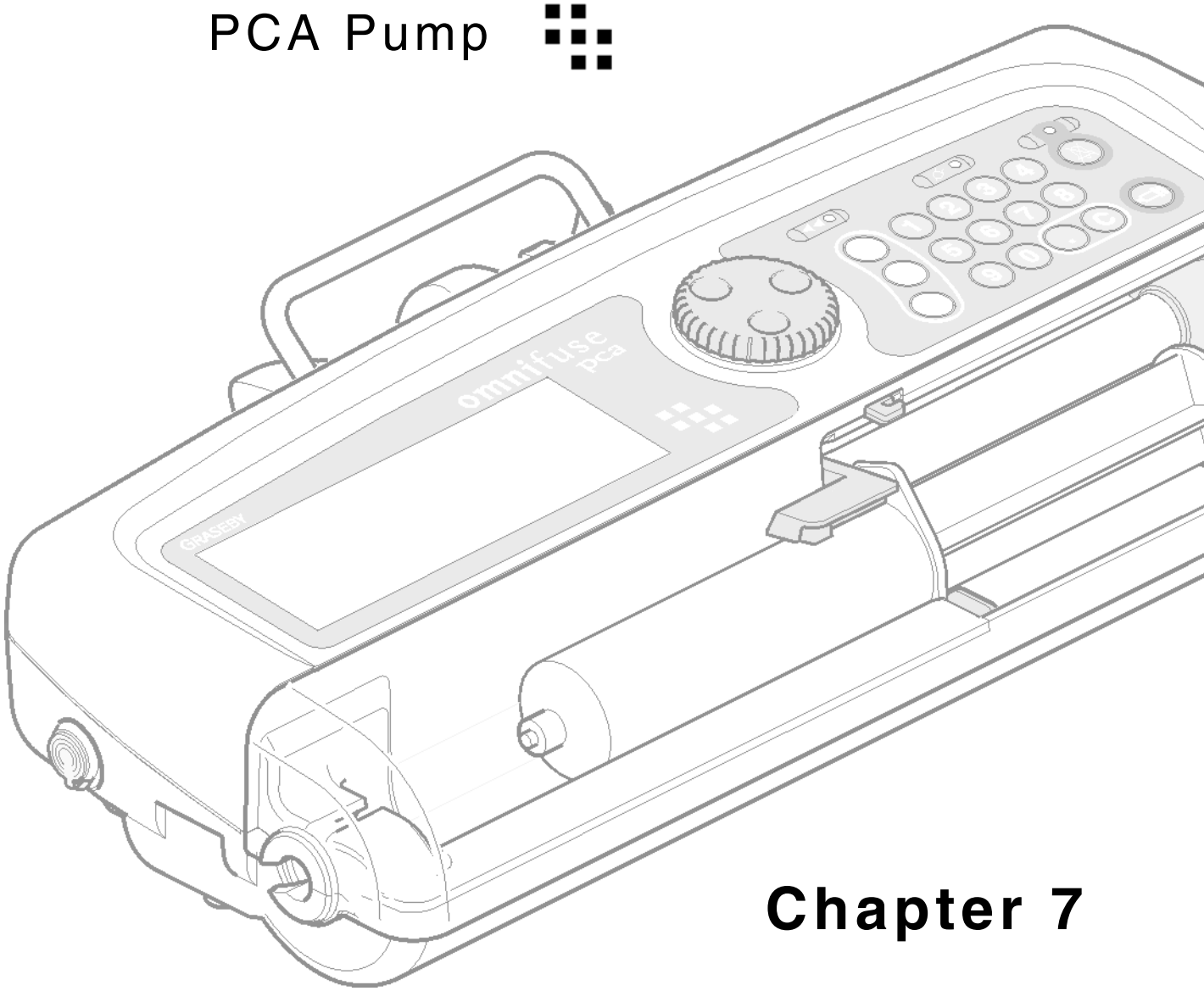
Syringe Pump

PCA Pump



Chapter 7

Specifications and Standards

Chapter 7 – Specifications and Standards

The Specification, Standards and Trumpet curves may be viewed in any of the following manuals:

Omnifuse™ Syringe Pump

English/ Australian/ Canadian (English)

- Omnifuse™ Syringe Pump Instruction Manual, *part number 0151-0839*
- Omnifuse™ Omnifuse™ Syringe Pump Technical User Manual, *part number 0151-0840*

French

- Omnifuse™ Syringe Pump Instruction Manual, *part number 0151-0862*
- Omnifuse™ Syringe Pump Technical User Manual, *part number 0151-0872*

Dutch

- Omnifuse™ Syringe Pump Instruction Manual, *part number 0151-0861*
- Omnifuse™ Syringe Pump Technical User Manual, *part number 0151-0872*

Omnifuse™ Syringe Pump, PCA

English/ Australian/ Canadian (English)

- Omnifuse™ Syringe Pump, PCA Instruction Manual, *part number 0153-0082*
- Omnifuse™ Syringe Pump, PCA Technical User Manual, *part number 0153-0083*

French

- Omnifuse™ Syringe Pump Instruction Manual, *part number 0151-0101*
- Omnifuse™ Syringe Pump Technical User Manual, *part number 0151-0111*

Dutch

- Omnifuse™ Syringe Pump Instruction Manual, *part number 0151-0100*
- Omnifuse™ Syringe Pump Technical User Manual, *part number 0151-0110*

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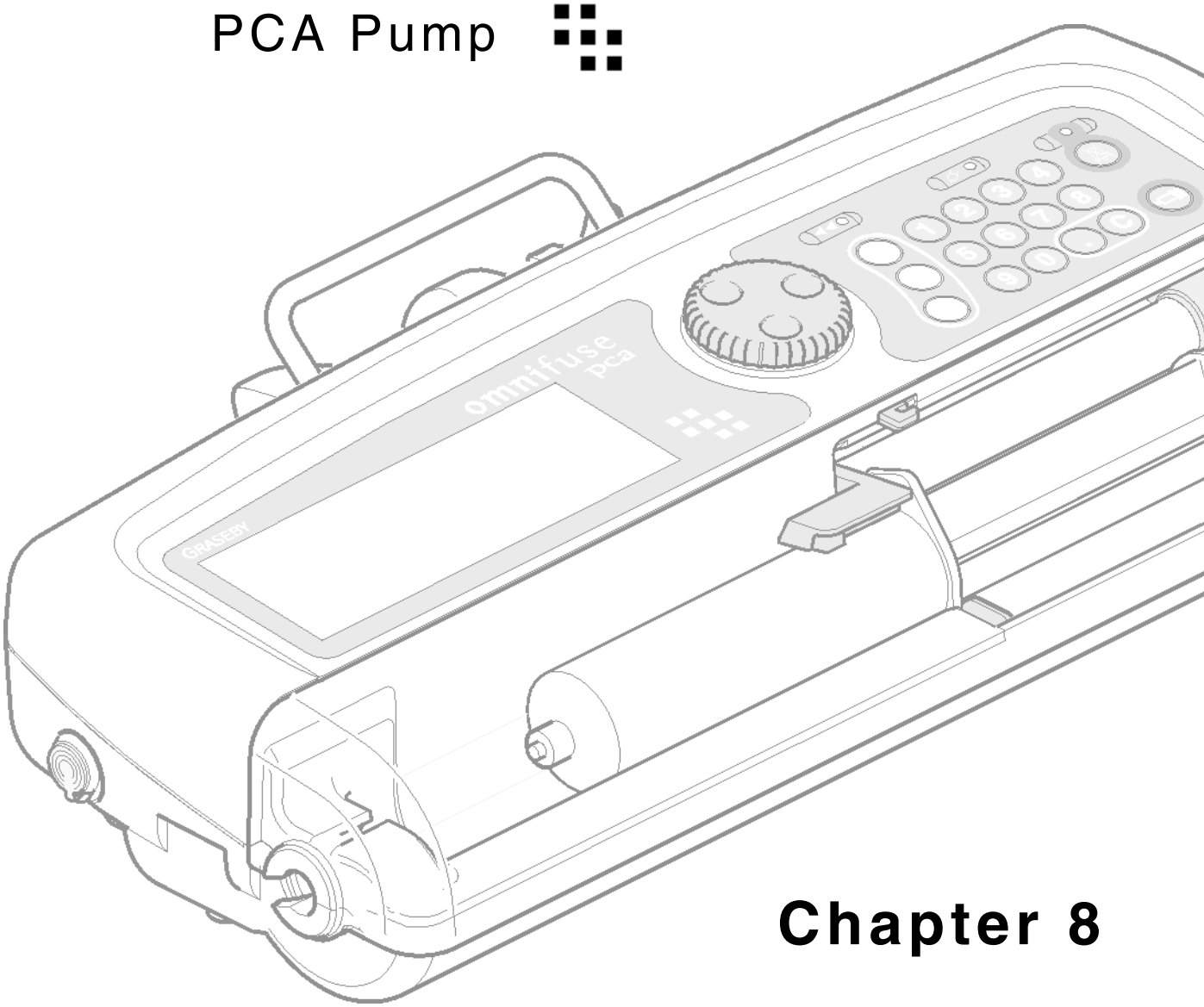
Syringe Pump

PCA Pump



Chapter 8

Serial Communications Protocol

Chapter 8 – Serial Communications Protocol

WARNING: While Smiths Medical International Limited have taken all reasonable steps to ensure that the pump operates correctly, while under remote control, it is the responsibility of the person who designs and implements the controlling device to ensure that the resulting system (pump and the controlling device) is fit for its intended purpose.

WARNING: The assessment for the suitability of any software/ firmware in the clinical environment to control or receive data from the pump lies with the user of the equipment. Any connecting analogue and digital components are required to meet BS EN600950-1:2002 / IEC 60950-1 (2001-10) for data processing and BSEN60601-1:1990 for medical devices.

WARNING: Any person connecting additional devices to the signal input or output is a system configurator and responsible for meeting the requirements of the system standard BS EN606010101:2001 / EIC 60601-1-1 (2000-12). Failure to do so may result in the compromised function of the product, patient injury or user injury.

Introduction

The Omnifuse™ syringe pump features an RS-232 serial interface.

This interface allows a computer to be connected to the pump for monitoring and/ or interface and control purposes.

Communications with the pump follows a master/ slave system with the external controller acting as the master and the pump as the slave.

This means that if appropriate computer software is written to communicate with the pump, a computer may be used to remotely monitor and document the patient's infusion and allow the operator to setup and change the infusion parameters.

This chapter defines the protocol to be used in software written to communicate with the pump through its RS-232 interface. It is assumed that the reader is familiar with the technical aspects of computer/ RS-232 interface software.

Organisation of this chapter

This chapter contains the following information:

- Safety considerations.
- Serial interface requirements.
- Message format.
- Communications link control.
- Enumerated data.
- Data format and ranges.
- Commands and responses.

Safety Considerations

The information returned from the pump should be checked against the values sent by the controller so as to detect any uncontrolled changes to the values. If the external controller detects a data mis-match, it will send a disconnect message to the pump.

The pump will only accept commands in the order which corresponds to that in which the user is required to enter data to operate the pump via the front panel keypad.

As the integrity of the communication link is important for the correct transfer of data, loss of communication, by whatever cause, must be detected by a communications time-out. As part of its communications loss detection, the pump has a communications time-out of 2 seconds. The external controller should have a communications time-out as part of its communications loss detection.

As pump communications time-out is 2 seconds, the external controller must send 'keep alive' messages at least every 2 seconds to keep the communications link alive.

Note that while the pump is in the infusing mode and connected to an external controller, a communications time-out will generate a pump operating alarm and stop the pump motor.

Receipt of a 'bad message' or a 'loss of communication' shall be interpreted as 'communication failure'.

On the detection of communication failure, the pump returns to the 'not connected' condition and is then ready to accept a new connection.

On the detection of communication failure by the external controller, one of the following actions shall occur:

1. If the external controller is controlling the pump it shall generate an alarm.
2. If the external controller is monitoring the pump, it shall wait for a time greater than the communications time-out and then attempt to connect to the pump again. It shall try to re-connect three times. If the third re-connect attempt fails then the external controller shall generate an alarm.

Bad Command received

Should the pump be unable to action a received command, an error flag will then be returned in the response to the command, but for some conditions, the following error message is returned instead.

{<address>NOL0006err:<message error>CRC}

After responding with this message, no further processing of the received message is performed by the pump.

The bad command errors are defined as follows:

Error Condition	Notes	<message error> value
Inappropriate command received while programming	Examples: Receipt of a command setting an infusion parameter inappropriate for the infusion mode; or a command setting an infusion parameter out of sequence.	E_ERR_WRONG_MODE
Inappropriate command for the pump's operating state	Examples: Receipt of a configuration command while in programming state; or receipt of a set infusion rate command while running an intermittent infusion.	E_ERR_WRONG_STATE

Command series error	When a 'Series' of messages is being transmitted, (see above), the same command must be used in every message of the series. If a command other than the original command is received in the series, this is an error.	E_ERR_NEW_COMMAND
Unrecognised command	The command received is not defined in this document.	E_ERR_UNRECOGNISED_ COMMAND
Parameter format error	Example: Text parameter when a number is expected, wrong number of parameters, numeric parameter does not conform to format.	E_ERR_PARAM_FORMAT
Command is not supported by the pump type currently connected.	This occurs when attempting to change pump parameters that need to be in a fixed state on certain pump types. Example: The lockable cover Configuration parameter must be set to Enabled on a 4300 (Omnifuse™ syringe pump, PCA), but is selectable Enabled/Disabled on a 4100 (Omnifuse™ syringe pump). Thus a 4100 will accept the command, whereas a 4300 will return this error status.	E_ERR_WRONG_PUMP_TYPE

Notes:

The conditions 'Unrecognised command' and 'Parameter format error' together will cover the situation where the message data contains a character which is out of the defined range.

If a command is setting values on the pump for which the corresponding feature is 'configured out', then this is indicated through error flags in the individual command response (rather than through use of the ERR: message).

Pump Control fields and acceptable states

The following rules apply:

- Control messages ('C') will only be accepted by the pump if the external controller has initiated control (see Generic Information 8 - 18) (i.e. following successful processing of a Control Initiate command).
- Technician commands (see Technician Commands 8 - 63) will only be accepted if the pump is in Technician state (i.e. following successful processing of a Set Technician State command).
- Configuration Commands (see Configuration Commands 8 - 44) will only be accepted if the pump is in Configuration state (i.e. following successful processing of a Set Configuration State command).

The following exception apply:

- The 'Enable Control' (CI:) command is itself a control command, but will be accepted when in monitoring mode.

Serial interface

RS232 interface

The pump is configured as Data Communications Equipment (DCE).

Channel Specification

- Baud rate:9600, 19200
- Data format:asynchronous, 8 data bits, 1 stop bit, no parity
- Flow control:none
- Signal levels:as defined in EIA-232 specification

MESSAGE FORMAT

Messages are of two types: Commands and Responses. Commands are sent from the external controller to the pump, a response is returned by the pump to the external controller.

All messages begin with a start character followed by a number of fields terminated by a stop character. All data, with the exception of 'free text', between the start and stop characters will conform to the ASCII standard and will be in the range 0x20 to 0x7A inclusive. This allows the messages to be observed using a simple terminal program. The message fields, in sequence, are as follows:

<start><address><control><status><series><sequence><length><data><CRC><stop>

Each field is explained briefly in the following table:

Field name	Field length (bytes)	Description
start	1	Message start character, '{' (0x7B).
address	8	Pump address, it is the pump serial number right justified with leading zeros added to fill the field. I.e. a pump with serial number "24" will have an address of "00000024".
control	1	This defines the type of message, the valid characters are: C = Control message M = Monitor message N = Network message
status	1	This allows the pump to request disconnection. The valid characters are: D = Disconnect Request O = Operating Note that this field has higher priority than the series field.

series	1	This defines whether the whole message is contained within this frame, is completed with this frame or if there is a series of frames to follow: S = series of frames L = last (or only frame) When a response is received with series = 'S' , the external controller must send the original command again each time it is ready to receive the next response frame in the series. When a command, sent by the external controller, has associated data which extends over more than one frame, then the original command will be repeated for each frame sent. The pump responds with a command response and parameter E_OK. This indicates that the external controller should send the next frame of data. Any other response should be considered an error. See Note 1.
sequence	1	This is a modulo 16 counter which is incremented each time a message is sent to or from the pump, allowing messages to be kept in sequence. (4 bit hex value converted to one ASCII character, upper case only.) For a broadcast message, the sequence field is set to zero (0x30) and is ignored by the recipient.
length	2	This is the length of the data field in bytes. (8 bit hex value converted to two ASCII characters, upper case only.)
data	3 – 235	The data field contains commands or responses to commands. Commands take the general form: <command>[<parameter1>;<parameter2>;…] Where <command> is a 2 to 5 character string, uppercase only followed by a ":" or a ":=". The response always returns the command string converted to lowercase again followed by a ":" or a ":=" as appropriate. The response is followed by zero or more parameters separated by semi-colons. Each parameter is a character string of variable length. Where the command string is followed by a ":=", the parameter(s) following the equals sign should be used to set value(s). If the command is accepted, the response will return the passed value after it is processed e.g. if the request is to store a value, the value is stored then the stored value is read back and included in the response.
CRC	4	CCITT CRC of all data from <address> to <data> inclusive. The CRC is defined as follows: Name:"CRC-16/CCITT" Width:16 bits Poly:0x1021 Init:0XFFFF RefIn:False RefOut:False XorOut:0x0000 Before inclusion in the message, the 16 bit CRC shall be converted to four ASCII characters, upper case only.

Stop	1	Message end character, '}' (0x7D).

Notes:

1. There are two distinct cases; one when the PC sends a multi-frame command and the other where a request results in a multi-frame response.

2. PC sends a multi-frame command:

Each command frame is sent with series = 'S' and is directly responded to with E_OK (series = 'L') and a copy of the original command (lower case).

The last frame in the command is sent with series = 'L' and all received data for the command is processed at this point. E_OK, E_NOTOK or E_NOT_AVAILABLE is returned dependent on the result of the processing.

3. Pump returns a multi-frame response:

On receipt of the command requesting data, if the request is valid, each frame of the response is returned with series = 'S', otherwise E_NOT_FOUND (or E_NOTOK) is returned with series = 'L'.

In response to all response frames with series = 'S' the command is resent to the pump with series = 'L'.

The last response frame is sent with series = 'L' and no further retransmissions of the original command is expected from the PC.

[contd]

4. Pump returns a multi-frame response:

On receipt of the command requesting data, if the request is valid, each frame of the response is returned with series = 'S', otherwise E_NOT_FOUND (or E_NOTOK) is returned with series = 'L'.

In response to all response frames with series = 'S' the command is resent to the pump with series = 'L'.

The last response frame is sent with series = 'L' and no further retransmissions of the original command is expected from the PC.

If the Pump is turned off during this sequence the next frame (not including

's) is returned with the status = 'D'. The PC responds with a disconnect message as specified elsewhere in this document.

ACR (Acknowledge, Constructing Response) commands can be sent at any time during these sequences and the same frame is resent (as is normal for ACR processing).

Message Assembly

On receipt of a start character, the external controller shall begin message assembly. It shall assume that a complete message has been received when the stop character is received, at which point the message shall be passed on for further processing. If a start character is received before a stop character, the current message shall be abandoned and message assembly shall be re-started.

Communications Link Control

This section describes the process required to establish and break a link between a pump and and an external controller.

Connection

This section describes the process to be followed to establish a connection with a pump.

1. External controller broadcasts a "who's out there" message.
   i.e. {00000000NOL004XID:<CRC>}

2. Pump(s) not already connected respond with an "I'm here" message containing the responding pump's address in the address field.
   e.g. {<pump address>NOL104xid:<CRC>}

3. The external controller responds with a "connect" message addressed to a specific pump.
   e.g. {<pump address>NOL204XLG:<CRC>}

4. The pump responds with a "connected" message, including a communications time-out, in seconds, to be used while the pump is not infusing.
   e.g. {<pump address>NOL306xlg:30<CRC>}

Disconnection

The disconnect sequence may be initiated from either the pump or the external controller.

As part of its power down sequence, the pump will set the Status field of its next command response, following a power down request, to "D".
If the pump has a pending power down request, it will respond to any command received (except for KAC: or XTC) with an err: (E_ERR_WRONG_STATE) message. On receipt of a response containing a disconnect request, the controller will send a disconnect command to the pump within 2 seconds. If a disconnect command is not received by the pump within 2 seconds (of sending a response with the Status = "D"), the pump will switch off. Since the pump may only receive a command every 30 seconds, there will be a maximum delay of 32 seconds before the pump actually powers down following a power down request.

The message sequence for the two situations is described below:

1. Initiated by the external controller:
   - External controller sends: {<pump address>NDL<n>04XTC:<CRC>}
   - Pump responds: {<pump address>NDL<n+1>04xtc:<CRC>}
2. Initiated by the pump:
   - Pump sends:
     {<pump address><control>D<series><n><data><CRC>}
   - External controller sends:
     {<pump address>NDL<n+1>04XTC:<CRC>}
   - Pump responds: {<pump address>NDL<n+2>04xtc:<CRC>}Keep Alive Message

If no other communication is required with the pump, this message should be sent to the pump at regular intervals to prevent the communications link from timing out.

The message sequence is as follows:

- External controller sends: {<pump address>NOL<n>04KAC:<CRC>}
- Pump responds: {<pump address>NOL<n+1>04kac:<CRC>}

Pump delay response

If the pump receives a command that requires construction of a response whose construction would delay the response transmission beyond the pump response time (70 ms), the pump will respond with an "acknowledge, constructing response" (acr) message:

{<pump address><control>OS<n+1>04acr:<CRC>}

As the series field is set to “S”, the controller should retransmit the command.
The pump will continue to send ACR messages until the response has been compiled.

Error Handling

Three types of error may occur:

- Bad message received
- Connection failure
- Bad command received

Bad message received or Connection failure

This section describes the strategy to be adopted in the event that:

- an error is detected in a message,
- the integrity of the physical connection is suspect, or
- either the pump or the external controller stops responding to messages.

Message retry, by the pump or the external controller, is not supported by this protocol. The following conditions shall be interpreted as a 'bad message':

Error Condition	Valid Range	<message error> value
Invalid address	"0" to "9"	None pump does not respond to a message not addressed to it.
Invalid character in control field	"C", "M", "N" or "T" only	E_ERR_CONTROL
Invalid character in status field	"D" or "O" only	E_ERR_STATUS
Invalid character in series field	"L" or "S" only	E_ERR_SERIES
Invalid character in sequence field	"0" to "9", "A", "B", "C", "D", "E" or "F" only	E_ERR_SEQUENCE
Out of sequence message received	n/a	E_ERR_NOT_SEQUENCE
Invalid character in length field	"0" to "9", "A", "B", "C", "D", "E" or "F" only	E_ERR_LENGTH
Data field length does not match the length specified in the length field of the message	n/a	E_ERR_DATA_LENGTH
Invalid character in CRC field	"0" to "9", "A", "B", "C", "D", "E" or "F" only	E_ERR_CRC_CHAR
CRC received does not match calculated (by receiver)	n/a	E_ERR_CRC
Total message length exceeded	Maximum message length including start and stop characters is 255 characters.	E_ERR_MESSAGE_LENGTH

When a pump receives a 'bad message', it returns an error message. The error message is defined as follows (where <message error> is as defined in the table above):

{<address>NOL0006err:<message error><CRC>}

The pump does no further processing of the received message. Note that the sequence number for an 'err' response will always be 0.

Enumerated Data

The enumerated data type width shall be one octet (8 bits): it is unsigned. The range of values which may be defined for enumerated data is 0 to 255 inclusive transmitted as two ASCII hex characters.

In the following definitions the enumerated data have been grouped for ease of reference.Message Errors and General Message Responses (00 – 2F)

The enumerated errors are defined in the following table:

Name	Value	Description
E_ERR_NOT_VALID	00	Error number received not within the defined range of error numbers.
E_ERR_CONTROL	01	Invalid character in control field.
E_ERR_STATUS	02	Invalid character in status field.
E_ERR_SERIES	03	Invalid character in series field.
E_ERR_SEQUENCE	04	Invalid character in sequence field.
E_ERR_NOT_SEQUENCE	05	Out of sequence message received.
E_ERR_LENGTH	06	Invalid character in length field.
E_ERR_DATA_LENGTH	07	Data field length does not match the length specified in the length field of the message.
E_ERR_CRC	08	CRC received does not match calculated (by receiver).
E_ERR_MESSAGE_LENGTH	09	Total message length exceeded.
E_ERR_CRC_CHAR	0A	Invalid character in CRC field.
E_ERR_NEW_COMMAND	10	New (different from original) command received while sending a series of responses.
E_ERR_UNRECOGNISED_ COMMAND	11	Unrecognised command.
E_ERR_PARAM_FORMAT	12	Parameter format error.
E_ERR_WRONG_PUMP_TYPE	1F	This command is not supported by the currently connected pump type.
E_ERR_WRONG_STATE	20	The pump is not in the correct state to perform this command.
E_ERR_WRONG_MODE	21	This command is inappropriate to the current infusion mode.
E_ERR_CLAMP_OPEN	22	Syringe clamp open (generated under the same conditions as the pump “CLAMP OPEN” warning).
E_ERR_NO_SYRINGE	23	No syringe loaded (generated under the same conditions as the pump “NO SYRINGE LOADED” warning).

E_ERR_NO_EAR_CLAMP	24	Syringe ear has not been clamped (generated under the same conditions as the pump “SYRINGE EAR NOT CLAMPED” warning).
E_ERR_COVER_OPEN	25	Syringe cover is open or unlocked (generated under the same conditions as the pump “COVER OPEN/UNLOCKED” warning).
E_ERR_NO_HANDSET	26	There is no handset fitted to the pump (generated under the same conditions as the pump “HANDSET NOT FITTED” warning).
E_ERR_SET_NEAR_EMPTY	27	The near empty setting is inappropriate (generated under the same conditions as the pump “SET NEAR EMPTY” warning).
E_ERR_NOT_READY	28	The pump shall respond with E_ERR_NOT_READY if the infusion cannot be started (for reasons other than ones which result in a specific error), e.g. when not all the infusion parameters have been entered.
E_ERR_PASSWD	29	The pump shall respond with this error if the password supplied does not match the password stored.

Infusion modes (30 – 3F)

Name	Value
E_CONTINUOUS	31
E_INTERMITTENT	32
E_PRESET_VOLUME	33
E_PRESET_TIME	34
E_PCA	35
E_PCS	36
Reserved	37
E_CIRCADIAN	38

Infusion units (40 – 4F)

Name	Value
E_ML_PER_H	41
E_ML_PER_MIN	42
E_MG_PER_KG_PER_H	43
E_MG_PER_KG_PER_MIN	44
E_UG_PER_KG_PER_H	45
E_UG_PER_KG_PER_MIN	46
E_MG_PER_H	47
E_MG_PER_MIN	48

E_UG_PER_H	49
E_UG_PER_MIN	4A
E_NG_PER_KG_PER_H	4B
E_NG_PER_KG_PER_MIN	4C
E_NG_PER_H	4D
E_NG_PER_MIN	4E

Message Errors and General Message Responses (50 – 8F)

Name	Value	Description
E_OK	51	General response, command was actioned.
E_NOTOK	52	General response, command was not actioned.
E_RANGE_ERR	53	Parameter value out of range.
E_INVALID_UNIT	54	Invalid units specified in a “set χχ units” message.
E_NOT_ENABLED	55	This feature is disabled on the pump.
E_NOT_AVAILABLE	56	This feature is not available on this pump.
E_VALID	57	Valid parameter value (used for sensor readings).
E_INVALID	58	Invalid parameter value.
E_LT	59	Less than (used as part of the error response to a parameter set command).
E_GT	5A	Greater than (used as part of the error response to a parameter set command).
E_STATUS_RESPONSE	5B	Status returned is specific to this command, not a general response as defined in this table.
E_INVALID_RATE	61	The given preset bolus dose and time generated an invalid bolus rate.
E_INVALID_TIME	62	The given preset bolus dose and rate generated an invalid bolus duration.
E_TIME	63	Time based near empty system or dose duration/cycle time specified as a time.
E_VOLUME	64	Volume based near empty system.
E_STAT	65	Dose duration = STAT (rate).
Reserved (was E_SINGLE)	66	Reserved (was Dose cycle time = single dose).
E_USER_RATE	67	Dose duration is set by users.
E_PAIN_SCORE_DISABLED	68	Pain score is disabled.
E_PAIN_SCORE_SEPARATE	69	Separate pain scoring for movement and at rest.
E_PAIN_SCORE_COMBINED	6A	Combined pain scoring for movement and at rest.
E_LED_OFF	6B	LED in Handset is OFF.

E_LED_CONTINUOUS	6C	LED in Handset is constantly illuminated.
E_LED_AVAILABLE	6D	LED in Handset is constantly illuminated.
E_PRIMARY	71	Main processor.
E_SECONDARY	72	Slave processor.
E_FORWARD	73	Direction of motor travel (for test purposes only).
E_BACKWARD	74	Direction of motor travel (for test purposes only).
E_OPEN	75	Open clamping arms.
E_CLOSE	76	Close clamping arms.
E_STEP_OPEN	77	Step clamping arms, opening.
E_STEP_CLOSE	78	Step clamping arms, closing.
E_RAMTEST	79	Start RAM test.
E_ROMTEST	7A	Start ROM test.
E_RED	7B	Backlight colour.
E_GREEN	7C	Backlight colour.
E_DAY	7D	Field descriptor for set RTC error.
E_MONTH	7E	Field descriptor for set RTC error.
E_YEAR	7F	Field descriptor for set RTC error.
E_YES	80	Yes (e.g. beep on bad demand).
E_NO	81	No (e.g. beep on bad demand).
E_LANGUAGE_1	82	Program language area 1.
E_LANGUAGE_2	83	Program language area 2.
E_232	84	RS232 port.
E_485	85	RS485 port.
E_SCORE_RANGE_0_TO_3	86	Scoring range for pain and nausea/sedation scores.
E_SCORE_RANGE_0_TO_10	87	Scoring range for pain and nausea/sedation scores.
E_SCORE_RANGE_0_TO_100	88	Scoring range for pain and nausea/sedation scores.
E_DRUG_NAME_ONLY	89	Drug name only.
E_DRUG_PROTOCOL	8A	Drug protocol loaded.

Mass Units Programming (90 – 9F)

Name	Value	Description
E_PROGMASS	90	Mass units programming.
E_PROGVOL	91	Volume units programming.
E_MG	92	mg units.

E_UG	93	µg units.
E_BOTH	94	For a parameter which can take value A, value B or both (A and B).
E_ML	95	ml units.
E_MG_PER_KG	96	mg/kg units.
E_UG_PER_KG	97	µg/kg units.
E_MG_PER_ML	98	mg/ml units.
E_UG_PER_ML	99	µg/ml units.
E_USER	9A	User mixed Drug concentration entry.
E_PRE	9B	Pre mixed Drug concentration entry.
E_NG	9C	ng units.
E_NG_PER_KG	9D	ng/kg units.
E_NG_PER_ML	9E	ng/ml units.

History storage (A0 – BF)

Name	Value	Description
E_CONFIG	A1	Refers to the configuration state or parameters.
E_GRASEBY	A2	Refers to the Graseby state or parameters.
E_SYRINGE	A3	Refers to the user-defined syringe parameters.
E_NOT_FOUND	A4	The requested item could not be found.
E_KG	B0	Patient weight.
E_US	B1	Motor step period units.
E_MM	B2	Used with syringe dimensions.
E_SQ_UM	B3	Syringe cross sectional area units.
E_MMHG	B4	Wetside occlusion limit units.

Data formats and ranges

This section describes the restrictions applying to parameter and textual data that forms part of the data field of a message.

Parameter Data

The following table defines the valid maximum and minimum ranges of, and formatting rules for, infusion parameters. The maximum and minimum parameter ranges may be further restricted by the settings in the pump. A 'parameter set' command that results in a parameter range violation will return a range error response with data that defines how the parameter range has been violated.

If any numerical parameter data does not conform to the format defined (by example) below, then an error shall be reported using the 'err:' response.

Parameter	Valid range	Format (defined by example)
Infusion rate (ml/h)	0.1 to 800	0.1 to 99.9, 100 to 800
Infusion rate (ml/min)	0.01 to 13.0	0.01 to 9.99, 10.0 to 13.0
Infusion rate (mg/kg/h)	0.1 to 99.9	0.1 to 9.9, 10.0 to 99.9
Infusion rate (mg/kg/min)	0.01 to 9.99	0.01 to 9.99
Infusion rate (µg/kg/h)	1 to 999	1 to 999
Infusion rate (µg/kg/min)	0.1 to 99.9	0.1 to 9.9, 10.0 to 99.9
Infusion rate (ng/kg/h)	1 to 999	1 to 999
Infusion rate (ng/kg/min)	0.1 to 99.9	0.1 to 9.9, 10.0 to 99.9
Infusion rate (mg/h)	0.1 to 500	0.1 to 99.9, 100 to 500
Infusion rate (mg/min)	0.01 to 50.0	0.01 to 9.99, 10.0 to 50.0
Infusion rate (µg/h)	0.2 to 999	0.2 to 99.9, 100 to 999
Infusion rate (µg/min)	0.02 to 99.9	0.02 to 9.99, 10.0 to 99.9
Infusion rate (ng/h)	0.2 to 999	0.2 to 99.9, 100 to 999
Infusion rate (ng/min)	0.02 to 99.9	0.02 to 9.99, 10.0 to 99.9
Dose / Loading Dose / Bolus Dose (ml)	0.1 to 99.9	0.1 to 99.9
Dose / Loading Dose / Bolus Dose (mg)	0.1 to 99.9	0.1 to 99.9
Dose / Loading Dose / Bolus Dose (µg)	0.1 to 999	0.1 to 99.9, 100 to 999
Dose / Loading Dose / Bolus Dose (ng)	0.1 to 999	0.1 to 99.9, 100 to 999
Dose / Loading Dose / Bolus Dose (mg/kg)	0.1 to 99.9	0.1 to 99.9
Dose / Loading Dose / Bolus Dose (µg/kg)	0.1 to 999	0.1 to 99.9, 100 to 999

Dose / Loading Dose / Bolus Dose (ng/kg)	0.1 to 999	0.1 to 99.9, 100 to 999
Bolus rate (ml/h)	0.1 to 800	0.1 to 99.9, 100 to 800
Bolus rate (ml/min)	0.01 to 13.0	0.01 to 9.99, 10.0 to 30.0
Patient weight (kg)	0.1 to 200	0.1 to 99.9, 100 to 200
Volume To Be Infused (ml)	0.05 to 99.9	0.05 to 9.99, 10.0 to 99.9
Drug Volume (ml)	0.1 to 60	0.1 to 9.9, 10.0 to 60.0
Drug mass (µg)	0.1 to 999	0.1 to 9.9, 10.0 to 99.9, 100 to 999
Drug mass (mg)	0.1 to 99.9	0.1 to 99.9
Drug mass (ng)	0.1 to 99.9	0.1 to 99.9
Drug Concentration (µg/ml)	0.01 to 999	0.01 to 9.99, 10.0 to 99.9, 100 to 999
Drug Concentration (mg/ml)	0.01 to 999	0.01 to 9.99, 10.0 to 99.9, 100 to 999
Drug Concentration (ng/ml)	0.01 to 999	0.01 to 9.99, 10.0 to 99.9, 100 to 999
Duration (MM:SS)	00:01 to 59:59	00:01 to 59:59
Duration (HH:MM)	00:01 to 24:00	00:01 to 24:00
Period (minutes)	1 to 360	1 to 360
Period (hours)	1 to 24	1 to 24
Dose limit (demand)	1 to 50	1 to 50
Dose limit (Mass or Vol)	1 to 999	1 to 999
KVO rate	0, 0.05 to 2	0, 0.05 to 0.09, 0.1 to 2 **Note:** KVO rate is in ml/h only.

Textual Data

Where a parameter defines 'free-text' for display (e.g. the syringe name) the range of allowable characters the can be used for strings is extended to 20-FF, with the exception that the '{', '}' and ';' (the message start and stop characters, and the field delimiter) shall not be included in the string.

Commands and Responses

Any parameter that starts with 'E_' is an enumerated data type – the enumerations are detailed earlier. The formatting and valid range for any parameter shown thus <<name>> is described in section. When setting parameter values, a convention has been adopted which reports 'value out of range' errors in response. This uses the E_RANGE_ERR enumeration, and includes a report of the limit transgressed by the supplied value.

Network messages

Command Name	Description	Transmitted Data			Response Data			Notes
		Control	Command	Parameters	Control	Command	Parameters	
Who's out there?	Broadcast message sent by the external controller (address field is set to 00000000 and the sequence number is 0)	N	XID:	None	N	xid:	None	Response message contains pump's actual address.
Connect	Use by the controller to connect to a pump which has replied to the who's there message	N	XLG:	None	N	xlg:	<timeout in seconds>	
Disconnect	Sent by either the external controller or the pump to close the link	N	XTC:	None	N	xtc:	None	If remote control has been established, this command will also terminate control.
Keep Alive	Sent by the external controller to prevent the link from timing out	N	KAC:	None	N	kac:	None	

Generic Information

Includes Date, Time, Manufacturing Details, current mode, alarm status, start computer control, etc.
'Manufacturers Data' and 'Read Status' commands are valid at all times once a connection has been established. In response to a set state command, the pump responds with a E_OK if it is already in the required state or on successful transition to the requested state.

Command Name	Description	Transmitted Data			Response Data			Notes
		Control	Command	Parameters	Control	Command	Parameters	
Manufacturers data	Reads the manufacturers data for the pump; pump type, installed options, hardware revisions, software versions, serial number.	M	MD:	None	M	md:	["4000" | "4100" | "4300" | "4500"]+";"+ "MB="+RL+";"+ "PB="+RL+";"+ "SB="+RL+";"+ ("WB="+RL+";"+) "MS="+VN+";"+ "SS="+VN+";"+ "CRC="CS+";"+ SN	MB - Main PCB revision PB - Power PCB revision SB - Syringe Pusher PCB revision WB - In-line sensor PCB revision MS - 'Main' processor software version SS - 'Slave' processor software version CRC – 'Main' pump software image CRC SN = NNNNNNNN /* Serial Number */ RL = 1{L}2 VN = (N)+N+"."+N VL = N+L CS = <HHHH> where H = ["0" to "9"] | ["A" to "F"]. N = ["0" to "9"] L = ["A" to "Z"]

Command Name	Description	Transmitted Data			Response Data			Notes
		Control	Command	Parameters	Control	Command	Parameters	
Read status	Command returns the pump operating status. i.e. Computer control mode, current pump mode and Operating alarm and Repeated Warning status.	M	STAT:	None	M	stat:	[“MN” | “CN”]+”;”+ [“CM” | “TM” | “PG” | “IN” | “RN” | “SP”]+”;”+	The following describe whether external control has been established by the external controller. MN - Monitoring only CN - External control established The following indicate the operating state of the pump. CM - Configuration state TM - Technician state PG - Programming state IN - Initialising (returning to programming state) RN - Running (infusing) SP - Suspended The following describe Operating Alarm condition on the pump. These notes correspond to the Long Message Title of the operating alarm.

Command Name	Description	Transmitted Data			Response Data			Notes
		Control	Command	Parameters	Control	Command	Parameters	
Read status (contd)							["NA" | "CO" | "OC" | "SE" | "BD" | "DL" | "SO" | "ST" | "SR" | "IC" | "NC" | "PF" | "OB" | "PL" | "ET" | "CF" | "LT" | "LI" | "IF"]+";"+	NA - Not alarming CO - Clamp opened OC - Occlusion SE - Syringe empty (note this covers several individual Operating Alarms) BD - Batteries 'dead' DL - Dose limit exceeded SO - Cover opened ST - Syringe tampering SR - Sensor removed IC - Infusion complete NC - Handset not connected PF - Handset power fail PL - Handset pressed too long OB - Obstruction ET - External Control Terminated CF - Communications Failure LT - Syringe load timeout LI - Syringe load incomplete IF - In-line sensor disc fitted

Command Name	Description	Transmitted Data			Response Data			Notes
		Control	Command	Parameters	Control	Command	Parameters	
Read status (contd)							["NW" | "NI" | "LB" | "NE" | "KVO" | "MF" | "VL" | "TE" | "BB" | "SF" | "CW" | "BF" | "RU" | "DE" | "FL" | "FS" | "FB" | "FH"]	The following describes the Repeated Warning condition on the pump. These notes correspond to the Long Message title of the Repeated Warning. NW - Not Infusing NI - Not Infusing LB - Low battery NE - Nearly empty (i.e. Warnings Time-based or Volume-based near empty detected) KVO- KVO MF - AC mains failure VL - Volume low TE - Pump too hot / cold BB - Back up battery low SF - Sounder failure CW - Communications Failure BF - Battery Faulty RU - Rate not changed DE - Bad demands exceeded FL - Faulty handset LED FS - Faulty handset switch FB - Faulty handset LED and switch FH - Handset failed (in-determinate)

Command Name	Description	Transmitted Data			Response Data			Notes
		Control	Command	Parameters	Control	Command	Parameters	
Initiate control	Command tells the pump that the external controller wants to take control of the pump.	C	CI:	None	C	ci:	[E_OK | E_NOTOK]	Control will only be passed to the external controller if the pump has been configured to enable External Control. Following the acceptance of a CI: command by the pump (i.e. the pump returned an E_OK response); on receipt of subsequent CI: commands by the pump, the pump shall respond with E_OK. This mechanism provides confirmation (for the external controller) that the pump is currently under remote control.
Terminate control	Command tells the pump that the external controller wants to relinquish control of the pump.	C	CT:	None	C	ct:	[E_OK | E_NOTOK]	**Note**: Sending this command while the pump is infusing will result in the pump raising an alarm, although the command will be actioned, i.e. external control will be terminated, and a E_OK response returned.
Set Programming State	Change the pump to the Programming State.	M	PGM:	None	M	pgm:	[E_OK | E_NOTOK]	

Command Name	Description	Transmitted Data			Response Data			Notes
		Control	Command	Parameters	Control	Command	Parameters	
Set Technician State	Change the pump to the Technician State.	M	TCH:=	<password string>	M	tch:=	[E_OK | E_NOTOK | E_ERR_PASSWD]	To exit Technician state, issue a Set Programming state command. The pump responds with an 'err:' response, E_ERR_WRONG_STATE if it is not in a state which allows a transition to Technician State. Otherwise, the pump responds with E_ERR_PASSWD if the password is invalid. Otherwise the pump responds with a E_NOTOK if the command cannot be actioned for another reason.
Set Configuration State	Change the pump to the Configuration State.	M	CFG:=	<password string>	M	cfg:=	[E_OK | E_NOTOK | E_ERR_PASSWD]	To exit Configuration state, issue a Set Programming state command. The pump responds with an 'err:' response, E_ERR_WRONG_STATE if it is not in a state which allows a transition to Configuration State. Otherwise, the pump responds with E_ERR_PASSWD if the password is invalid. Otherwise the pump responds with a E_NOTOK if the command cannot be actioned for another reason.

Infusion Device Commands

Includes: Infusion modes available, Current Infusion Mode, Infusion Rate (volume), Infusion Rate (mass) and Patient Weight.

Infusion Device Command Usage

Note the infusion mode is set by the 'IM:=' command.

Infusion Parameters	Continuus	Intermitent	Pre-set vol.	Preet time	PCA	PCS	Circadian	Serial comand	Notes
Infusion units	ml/h ml/mn mg/min µg/h µg/min mg/h mg/kg/h mg/kg/min µg/kg/h µg/kg/min ng/h ng/min ng/kg/h ng/kg/min	(ml/h mg/h µg/h mg/kg/h µg/kg/h ng/h ng/kg/h)	(ml/h only)		(ml/h mg/h µg/h mg/kg/h µg/kg/h ng/kg/h)	(mg/kg/h µg/kg/h)		IU:=	
Infusion rate (corresponding to Infusion units setting)	Numeric	(numeric)	numeric					IR:=	
Background rate		numeric			numeric	numeric		BR:=	
Conc. Type	user pre-mix	user pre-mix			(pre-mix only)	(pre-mix only)	(pre-mix only)	COT:=	Used solely in setting drug concentration.
Drug mass units	mg µg ng	mg µg ng						DMU:=	Used solely in setting drug concentration.
Drug mass	numeric	numeric						DRM:=	Used solely in setting drug concentration.

Infusion Parameters	Continuus	Intermitent	Pre-set vol.	Preet time	PCA	PCS	Circadian	Serial comand	Notes
Drug volume (ml)	numeric	numeric						DRV:=	Used solely in setting drug concentration.
Drug concentration units	mg/ml µg/ml ng/ml	mg/ml µg/ml ng/ml			mg/ml µg/ml ng/ml	mg/ml µg/ml ng/ml	mg/ml µg/ml ng/ml	DCU:=	Used solely in setting drug concentration.
Drug concentration	numeric	numeric			numeric	numeric	numeric	DRC:=	Used solely in setting drug concentration.
Dose units		ml, mg, µg, mg/kg, µg/kg, ng, ng/kg	(ml only)	(ml only)	(ml mg µg ng)	(ml mg/kg µg/kg ng/kg)	(ml mg/kg µg/kg ng/kg)	DOU:=	
Patient weight (kg only)	numeric	Numeric				Numeric	Numeric	WT:=	
Dose / Bolus Dose / Volume To Be Infused		Numeric	Numeric	Numeric	Numeric	Numeric	Numeric	DOS:=	
Dose duration (HH:MM)		Time		time				DOD:=	
Dose cycle time (HH:MM)		Time						CYCL:=	
Start delay (HH:MM)		Time						STY:=	
Loading dose (PCA/ PCS)					Numeric	Numeric		LDO:=	
PCA/PCS Bolus Dose duration (mins)					Numeric	Numeric		BDU:=	
Lock-Out period (mins)					Numeric	Numeric		LOP:=	
Dose Limit Time (hrs)					Numeric	Numeric		DLP:=	
Dose limit (demands/ mass or vol.)					Numeric	Numeric		TDL:=	
Select Circadian hour							Numeric	CIP:=	

Items in ( ) are either single fixed value or the value is determined by some other selection, in either case the user cannot set these values directly.

Infusion Device Commands Definition

Command Name	Description	Transmitted Data			Response Data			Notes
		Control	Command	Parameters	Control	Command	Parameters	
Read infusion modes	Reads the infusion modes available for this pump.	M	IMA:	None	M	ima:	E_CONTINUOUS (+";"+E_INTERMITTENT) (+";"+E_PRESET_VOL) (+";"+E_PRESET_TIME) (+";"+E_CIRCADIAN) (+";"+E_PCA) (+";"+E_PCS)	The infusion modes are returned as enumerated data.
Read infusion unit	Read the infusion unit currently set.	M	IU:	None	M	iu:	E_ML_PER_H | E_ML_PER_MIN | E_MG_PER_H | E_MG_PER_MIN | E_UG_PER_H] E_UG_PER_MIN | | E_NG_PER_H] E_NG_PER_MIN | E_MG_PER_KG_PER_H | E_MG_PER_KG_PER_MIN | E_UG_PER_KG_PER_H | E_UG_PER_KG_PER_MIN] E_NG_PER_KG_PER_H | E_NG_PER_KG_PER_MIN]	**Note**: The units are returned as enumerated data.

Command Name	Description	Transmitted Data			Response Data			Notes
		Control	Command	Parameters	Control	Command	Parameters	
Set infusion unit	Sets the infusion unit.	C	IU:=	E_ML_PER_H | E_ML_PER_MIN | E_MG_PER_H | E_MG_PER_MIN | E_UG_PER_H] E_UG_PER_MIN | | E_NG_PER_H] E_NG_PER_MIN | E_MG_PER_KG_PER_H | E_MG_PER_KG_PER_MIN | E_UG_PER_KG_PER_H | E_UG_PER_KG_PER_MIN] E_NG_PER_KG_PER_H | E_NG_PER_KG_PER_MIN]	C	iu:=	[E_OK+";"+<infusion unit set> | E_NOTOK]	
Read volume rate	Reads the volume infusion rate in ml/hr for the current infusion.	M	RT:	None	M	rt:	[E_OK+";"+<<Infusion rate (ml/h)>> | E_INVALID]	This is the value derived by pump software when an infusion is started. The response E_INVALID will be returned if the infusion rate in ml/hr is derived from other parameters that have not yet been set. The infusion rate formatting is dependant on the infusion units setting (see page 8 - 17))
Read infusion rate	Reads the infusion rate in the currently set infusion rate units.	M	IR:	None	M	ir:	<<Infusion rate>>	The infusion rate formatting is dependant on the infusion units setting (see page 8 - 17)

Command Name	Description	Transmitted Data			Response Data			Notes
		Control	Command	Parameters	Control	Command	Parameters	
Set infusion rate	Set the infusion rate (in the currently set infusion rate units) to the value passed as parameter.	C	IR:=	<<Infusion rate>>	C	ir:=	[E_OK+";"+<<Infusion rate set>> | E_RANGE_ERR+";"+E_LT+";"+ <Infusion rate lower limit> | E_RANGE_ERR+";"+E_GT+";"+ <Infusion rate upper limit>]	The infusion rate valid range and formatting is dependant on the infusion units setting (see page 8 - 15). Note that it is necessary to follow this with a Start Infusion (SI:) command within 5 seconds to cause the pump to infuse at the newly specified rate. If the SI: command is not received within 5 seconds, then the change rate is effectively cancelled.
Read background rate	Reads the background infusion rate.	M	BR:	None	M	br:	<<Infusion rate>>	The background infusion rate formatting is dependant on the infusion units setting (see page 8 - 15).
Set background rate	Sets the background infusion rate.	C	BR:=	<<Infusion rate>>	C	br:=	[E_OK+";"+<<Infusion rate set>> | E_RANGE_ERR+";"+E_LT+";"+ <Infusion rate lower limit> | E_RANGE_ERR+";"+E_GT+";"+ <Infusion rate upper limit>]	The background infusion rate valid range and formatting is dependant on the infusion units setting (see page 8 - 15).
Read conc. type	Reads the currently set (or only) method of drug concentration entry.	M	COT:	None	M	cot:	[E_USER | E_PRE]	.
Set conc. type	Sets the method of drug concentration entry.	C	COT:=	[E_USER | E_PRE]	C	cot:=	[E_OK+";"+<Method set> | E_NOTOK]	The response E_NOTOK will be returned if the requested method of drug concentration entry is not enabled.
Read drug mass units	Reads the drug mass unit currently set.	M	DMU:	None	M	dmu:	[E_MG | E_UG| E_NG]	This command relates to user mix drug concentration programming.

Command Name	Description	Transmitted Data			Response Data			Notes
		Control	Command	Parameters	Control	Command	Parameters	
Set drug mass units	Sets the drug mass unit used for the current infusion.	C	DMU:=	[E_MG | E_UG| E_NG]	C	dmu:=	[E_OK+";"+<Unit set> | E_INVALID_UNIT]	This command relates to user mix drug concentration programming. The pump responds with E_INVALID UNIT if the command parameter passed cannot be accepted.
Read drug mass	Reads the drug mass currently set.	M	DRM:	None	M	drm:	<<Drug mass>>	This command relates to user mix drug concentration programming.
Set drug mass	Sets the drug mass for the current infusion.	C	DRM:=	<<Drug mass>>	C	drm:=	[E_OK+";"+<<Drug mass set>> | E_RANGE_ERR+";"+E_LT+ ";"+ <Drug mass lower limit> | E_RANGE_ERR+";"+E_GT+ ";"+ <Drug mass upper limit>]	This command relates to user mix drug concentration programming.
Read drug volume	Reads the drug volume for the current infusion.	M	DRV:	None	M	drv:	<<Drug volume>>	This command relates to user mix drug concentration programming. The value is in ml.
Set drug volume	Sets the drug volume for the current infusion.	C	DRV:=	<<Drug volume>>	C	drv:=	[E_OK+";"+<<Drug volume set>> | E_RANGE_ERR+";"+E_LT+ ";"+ <Drug volume lower limit> | E_RANGE_ERR+";"+E_GT+ ";"+ <Drug volume upper limit>]	This command relates to user mix drug concentration programming. The value is in ml.
Read drug concent-ration units	Reads the drug concentration units for the current infusion.	M	DCU:	None	M	dcu:	[E_MG_PER_ML | E_UG_PER_ML | E_NG_PER_ML]	This command relates to pre-mix drug concentration programming.

Command Name	Description	Transmitted Data			Response Data			Notes
		Control	Command	Parameters	Control	Command	Parameters	
Set drug concentration units	Sets the drug concentration units for the current infusion.	C	DCU:=	[E_MG_PER_ML | E_UG_PER_ML | E_NG_PER_ML]	C	dcu:=	[E_OK;<value as set> | E_INVALID_UNIT]	This command relates to pre-mix drug concentration programming. The pump responds with E_INVALID UNIT if the command parameter passed cannot be accepted.
Read drug concentration	Reads the drug concentration which has been set.	M	DRC:	None	M	drc:	<<Drug concentration>>	The drug concentration valid range and formatting is dependant on the drug concentration units setting (see page 8 - 15).
Set drug concentration	Sets the drug concentration for the current infusion.	C	DRC:=	<<Drug concentration>>	C	drc:=	[E_OK+";"+<<Drug concentration set>> | E_RANGE_ERR+";"+E_LT+";"+ <Drug concentration lower limit> | E_RANGE_ERR+";"+E_GT+";"+ <Drug concentration upper limit>]	This command relates to pre-mix drug concentration programming.
Read dose duration	Reads the dose duration for the current infusion.	M	DOD:	None	M	dod:	[E_TIME+";"+ <<Duration>>]	
Set dose duration	Sets the dose duration for the current infusion.	C	DOD:=	[E_TIME+";"+ <<Duration (HH:MM)>>]	C	dod:=	[E_OK+";"+ [E_TIME+";"+<<Duration (HH:MM)>>] | E_RANGE_ERR+";"+E_LT+";"+ <Dose Duration lower limit> | E_RANGE_ERR+";"+E_GT+";"+ <Dose Duration upper limit>]	

Command Name	Description	Transmitted Data			Response Data			Notes
		Control	Command	Parameters	Control	Command	Parameters	
Read dose cycle time	Reads the dose cycle time for the current infusion.	M	CYCL:	None	M	cycl:	[E_TIME+";"+ <<Duration (HH:MM)>>]	
Set dose cycle time	Sets the dose cycle time for the current infusion.	C	CYCL:=	[E_TIME+ ";"+<<Duration (HH:MM)>>]	C	cycl:=	[E_OK+";"+ [E_TIME+";"+<<Duration (HH:MM)>>] | E_RANGE_ERR+";"+E_LT+";"+ <Dose Cycle Time lower limit> | E_RANGE_ERR+";"+E_GT+";"+ <Dose Cycle Time upper limit>]	
Read start delay	Reads the start delay set.	M	STY:	None	M	sty:	<<Duration (HH:MM)>>	
Set start delay	Sets the start delay for the current infusion.	C	STY:=	<<Duration (HH:MM)>>	C	sty:=	[E_OK+";"+<<Duration (HH:MM) as set>> | E_RANGE_ERR+";"+E_LT+";"+ <Start Delay lower limit> | E_RANGE_ERR+";"+E_GT+";"+ <Start Delay upper limit>]	
Read dose units	Reads the dose units set.	M	DOU:	None	M	dou:	[E_ML | E_MG | E_UG | E_MG_PER_KG | E_UG_PER_KG]	
Set dose units	Sets the dose units for the current infusion.	C	DOU:=	[E_ML | E_MG | E_UG | E_MG_PER_KG | E_UG_PER_KG]	C	dou:=	[E_OK+";"+ <Dose Units set> | E_INVALID_UNIT]	The pump responds with E_INVALID UNIT if the command parameter passed cannot be accepted.

Command Name	Description	Transmitted Data			Response Data			Notes
		Control	Command	Parameters	Control	Command	Parameters	
Read dose	Reads the dose in the currently selected dose units set.	M	DOS:	None	M	dos:	<<Dose>>	The dose valid range and formatting is dependant on the dose units setting (seepage 8 - 15).
Set dose	Sets the dose (in the currently selected dose units) for the current infusion.	C	DOS:=	<<Dose>>	C	dos:=	[E_OK+";"+<<Dose set>> | E_RANGE_ERR+";"+E_LT+ ";"+ <Dose lower limit> | E_RANGE_ERR+";"+E_GT+ ";"+ <Dose upper limit>]	The dose valid range and formatting is dependant on the infusion units setting (see page 8 - 15).
Read loading dose	Reads the loading dose set.	M	LDO:	None	M	ldo:	<<Loading Dose>>	The value will be in units which depend on the configuration of the pump and the drug concentration units selected in PCA/ PCS mode (see page 8 - 15).
Set loading dose	Sets the loading dose for the current infusion.	C	LDO:=	<<Loading Dose>>	C	ldo:=	[E_OK+";"+<<Loading Dose set>> | E_RANGE_ERR+";"+E_LT+ ";"+ <Loading Dose lower limit> | E_RANGE_ERR+";"+E_GT+ ";"+ <Loading Dose upper limit>]	The value will be in units which depend on the configuration of the pump and the drug concentration units selected in PCA/ PCS mode (see page 8 - 15).
Read bolus dose duration	Read the PCA/PCS bolus dose duration.	M	BDU:	None	M	bdu:	<<Period (minutes)>>	

Command Name	Description	Transmitted Data			Response Data			Notes
		Control	Command	Parameters	Control	Command	Parameters	
Set bolus dose duration	Set the PCA/PCS bolus dose duration.	C	BDU:=	<<Period (minutes)>>	C	bdu:=	[E_OK+";"+<<Period (minutes) set>> | E_RANGE_ERR+";"+E_LT+ ";"+ <Bolus Dose Duration lower limit> | E_RANGE_ERR+";"+E_GT+ ";"+ < Bolus Dose Duration upper limit>]	
Read lock out period	Reads the lock out period set.	M	LOP:	None	M	lop:	<<Period (minutes)>>	
Set lock out period	Sets the lock out period for the current infusion.	C	LOP:=	<<Period (minutes)>>	C	lop:=	[E_OK+";"+<<Period (minutes)>> | E_RANGE_ERR+";"+E_LT+ ";"+ <Lock Out Period lower limit> | E_RANGE_ERR+";"+E_GT+ ";"+ <Lock Out Period upper limit>]	
Read dose limit time	Reads the dose limit time set.	M	DLP:	None	M	dlp:	<<Period (hours)>>	
Set dose limit time	Sets the dose limit time for the current infusion.	C	DLP:=	<<Period (hours)>>	C	dlp:=	[E_OK+";"+<<Period (hours)>> | E_RANGE_ERR+";"+E_LT+ ";"+ <Dose Limit Time lower limit> | E_RANGE_ERR+";"+E_GT+ ";"+ <Dose Limit Time upper limit>]	

Command Name	Description	Transmitted Data			Response Data			Notes
		Control	Command	Parameters	Control	Command	Parameters	
Read dose limit	Reads the dose limit for the current infusion.	M	TDL:	None	M	tdl:	<<Dose limit>>	
Set dose limit	Sets the dose limit for the current infusion.	C	TDL:=	<<Dose limit>>	C	tdl:=	[E_OK+";"+<<Dose limit set>> | E_RANGE_ERR+";"+E_LT+";"+ <Dose limit lower limit> | E_RANGE_ERR+";"+E_GT+";"+ <Dose limit upper limit>]	
Read current Circadian infusion period	Read which hour of a 24 hour circadian rhythm infusion the pump is currently infusing.	M	CIP:	None	M	cip:	[E_OK+";"+<1 to 24> | E_NOTOK]	The pump responds with E_OK if this command is received whilst Running a Circadian infusion. Under other conditions it responds with E_NOTOK.
Set the Circadian infusion period	Set the hour of a 24 hour circadian rhythm infusion for which the user is reading or setting infusion parameters.	C	CIP:=	<1 to 24>	C	cip:=	[E_OK+";"+<period set> | E_RANGE_ERR+";"+E_LT+";"+ <period lower limit> | E_RANGE_ERR+";"+E_GT+";"+ <period upper limit>]	This command is used during programming of a Circadian infusion. It can be following by a Set/ Get Dose command, which it will apply to the specified hour.
Read Patient Weight	Read the value of the patient weight set.	M	WT:	None	M	wt:	<<Patient weight>>	
Set Patient Weight	Sets the patient weight (in kg only).	C	WT:=	<<Patient weight>>	C	wt:=	[E_OK+";"+<<Patient weight set>> | E_RANGE_ERR+";"+E_LT+";"+ <Patient weight lower limit> | E_RANGE_ERR+";"+E_GT+";"+ <Patient weight upper limit>]	

General Commands

These commands will be accepted in all states except Technician and Configuration. Note that 'C' Type Control Commands can only be accepted when Pump is under external control.

Command Name	Description	Transmitted Data			Response Data			Notes
		Control	Command	Parameters	Control	Command	Parameters	
Read dry side occlusion pressure	Reads the dry side occlusion 'pressure' and returns its value.	M	DOC:	None	M	doc:	[E_OK+";"+<0.0 to 5.0> | E_NOTOK]	The value returned is in arbitrary units and is not contiguous, (i.e. the values are {0.0, 0.1, 0.2, 1.0, 1.1, 1.2, 2.0, 2.1 …}. If there is no syringe loaded, this command will always return a zero value in the response.
Read in-line occlusion pressure	Reads the in-line occlusion pressure and returns its value.	M	WOC:	None	M	woc:	[E_OK+";"+<0 to 1000> | E_NOTOK]	The value is returned in mmHg. E_NOTOK will be used to indicate that the command could not be processed because the parameter is unavailable through higher-level configuration settings. If there is no syringe loaded, this command will always return a zero value in the response.
Read dry side occlusion limit	Reads the current setting for the dry side occlusion pressure alarm limit.	M	DOL:	None	M	dol:	<1 to 5>	The value returned is in arbitrary units.

Command Name	Description	Transmitted Data			Response Data			Notes
		Control	Command	Parameters	Control	Command	Parameters	
Set dry side occlusion limit	Sets the dry side occlusion pressure alarm limit.	C	DOL:=	<1 to 5>	C	dol:=	[E_OK+";"+<value as set> | E_RANGE_ERR+";"+E_LT+";"+ <DSOAL lower limit> | E_RANGE_ERR+";"+E_GT+";"+ <DSOAL upper limit>> | E_NOTOK]	Where DSOAL means the dry-side occlusion alarm limit in arbitrary units. E_NOTOK will be used to indicate that the command could not be processed because in-line pressure sensing is enabled.
Read in-line occlusion limit	Reads the current setting for the in-line occlusion pressure alarm limit.	M	WOL:	None	M	wol:	[E_OK+";"+<0 to 1000> | E_NOTOK]	The value is returned in mmHg. E_NOTOK will be used to indicate that the command could not be processed because the parameter is unavailable through higher-level configuration settings.
Set in-line occlusion limit	Sets in-line occlusion pressure alarm limit.	C	WOL:=	<0 to 1000>	C	wol:=	[E_OK+";"+<value as set> | E_RANGE_ERR+";"+E_LT+";"+ <ILOAL lower limit> | E_RANGE_ERR+";"+E_GT+";"+ <ILOAL upper limit> | E_NOTOK]	Where ILOAL means the in-line occlusion alarm limit in mmHg. E_NOTOK will be used to indicate that the command could not be processed because the parameter is unavailable through higher-level configuration settings.
Read infusion mode	Reads the infusion mode the pump is currently set to.	M	IM:	None	M	im:	[E_CONTINUOUS | E_INTERMITTENT | E_PRESET_VOLUME | E_PRESET_TIME | E_PCA | E_PCS | E_CIRCADIAN]	

Command Name	Description	Transmitted Data			Response Data			Notes
		Control	Command	Parameters	Control	Command	Parameters	
Set infusion mode	Sets the infusion mode for the current pump.	C	IM:=	[E_CONTINUOUS | E_INTERMITTENT | E_PRESET_VOLUME | E_PRESET_TIME | E_PCA | E_PCS | E_CIRCADIAN]	C	im:=	[E_OK+";"+<mode set> | E_NOT_AVALIABLE]	E_NOT_AVALIABLE will be returned if the requested infusion mode is not available / enabled on the pump.
Get pump type	Gets the pump type.	M	PUMP:	None	M	pump:	["4000" | "4100" | "4300"] | [E_NOTOK]	This command is accepted in all states.

Infusion Control Commands

Includes, Start infusion, suspend infusion, stop infusion, perform hands free bolus.

Command Name	Description	Transmitted Data			Response Data			Notes
		Control	Command	Parameters	Control	Command	Parameters	
Start Infusion	Starts the infusion when the pump is in the programming or suspended states.	C	SI:	None	C	si:	[E_OK | E_ERR_CLAMP_OPEN | E_ERR_NO_SYRINGE | E_ERR_COVER_OPEN | E_ERR_NO_HANDSET | E_ERR_WRONG_STATE | E_ERR_NOT_READY]	A response other than E_OK indicates that the infusion has not been started. The pump shall respond with E_ERR_NOT_READY if the infusion cannot be started (for reasons other than ones which result in a specific error), e.g. when not all the infusion parameters have been entered.
Suspend infusion	Suspends the infusion. Will also stop any bolus infusion in progress.	C	SPI:	None	C	spi:	[E_OK | E_NOTOK]	
Stop infusion	Terminates the infusion when the pump is in the suspended state.	C	STP:	None	C	stp:	[E_OK | E_NOTOK]	Equivalent to a long stop key press when the pump is suspended.
Read preset Bolus	Read dose, rate and time settings for the preset bolus.	M	BLS:	None	C	bls:	<<Dose>>+";"+ <<Infusion rate>>+";"+ <<Duration (MM:SS)>>	The parameters are respectively: Preset Bolus Dose, Preset Bolus Rate and Bolus Time. In the returned values, the infusion rate is in ml/h.

Command Name	Description	Transmitted Data			Response Data			Notes
		Control	Command	Parameters	Control	Command	Parameters	
Set preset Bolus dose	Configure preset bolus dose.	C	BLSD:=	<<Dose>>	C	blsd:=	[E_OK+";"+<<Dose set>>+";"+<<Infusion rate (ml/h)>>+";"+<<Duration (MM:SS)>> | E_INVALID_TIME | E_RANGE_ERR+";"+E_LT+";"+<Preset Bolus Dose lower limit> | E_RANGE_ERR+";"+E_GT+";"+<Preset Bolus Dose upper limit>]	In the returned values, the parameters are respectively: • The Preset Bolus Dose value set in the command. • The currenly set Preset Bolus Rate. • The derived Preset Bolus Duration. E_INVALID_TIME is returned if the derived Preset Bolus Duration is out of range.
Set preset Bolus rate	Configure preset bolus rate.	C	BLSR:=	<<Infusion rate (ml.h)>>	C	blsr:=	[E_OK+";"+<<Dose>>+";"+<<Infusion rate (ml.h) set>>+";"+<<Duration (MM:SS)>> | E_INVALID_TIME | E_RANGE_ERR+";"+E_LT+";"+<Preset Bolus rate lower limit> | E_RANGE_ERR+";"+E_GT+";"+<Preset Bolus rate upper limit>]	In the returned values, the parameters are respectively: • The currently set Preset Bolus Dose value. • The Preset Bolus Rate set in the command. • The derived Preset Bolus Duration. E_INVALID_TIME is returned if the derived Preset Bolus Duration is out of range.

Command Name	Description	Transmitted Data			Response Data			Notes
		Control	Command	Parameters	Control	Command	Parameters	
Set Preset Bolus time	Configure preset bolus time.	C	BLST:=	<<Duration (MM:SS)>>	C	blst:=	[E_OK+";"+<<Dose>>+";"+<<Infusion rate (ml/h)>>+";"+<<Duration (MM:SS) set>> | E_INVALID_RATE | E_RANGE_ERR+";"+E_LT+";"+<Preset Bolus Duration lower limit> | E_RANGE_ERR+";"+E_GT+";"+<Preset Bolus Duration upper limit>]	In the returned values, the parameters are respectively: • The derived Preset Bolus Dose value. • The currently set Preset Bolus Rate. • The Preset Bolus Duration set in the command. E_INVALID_RATE is returned if the derived Preset Bolus Rate is out of range.
Start bolus	Start a preset bolus infusion	C	SB:	None	C	sb:	[E_OK | E_NOTOK]	
Stop bolus	Stops the bolus infusion in progress but does not suspend the main infusion.	C	STPB:	None	C	stpb:	[E_OK | E_NOTOK]	

History Commands

Includes Get History and totalisers.

Command Name	Description	Transmitted Data			Response Data			Notes
		Control	Command	Parameters	Control	Command	Parameters	
Get dates	Read start and end dates for the history events (i.e. date of oldest event and date of newest event).	M	HGD:	None	M	hgd:	[E_OK+";"+ <DD/MM/YYYY>+";"+ <DD/MM/YYYY > | E_NOTOK]	First date returned is the date of the oldest history event, second date is the date of the newest history event. E_NOTOK is returned if this information cannot be retrieved from the history store.
Read history	Get history events for a specified range of dates. This command will return all history events within this date range (inclusive of start and end date).	M	HGE:	<DD/MM/YYYY>+";"+ <DD/MM/YYYY>	M	hge:	Frame 1: E_OK+";"+ VN | E_NOT_FOUND | E_NOTOK] Frame 2: 1{<event data>}3000	VN is the primary software version in the form (N)+N+"."+N The returned event may span more than one message frame, if this is the case fields should not be split across frames. A new response frame will be started for each new event. If a event is split across message frames, the format of the <event data> must delineate event beginning and end. The format must also include the timestamp and event type of each event.

Command Name	Description	Transmitted Data			Response Data			Notes
		Control	Command	Parameters	Control	Command	Parameters	
Get parameter history	Retrieves the requested parameter store.	M	HCG:	[E_CONFIG | E_SYRINGE | E_GRASEBY]	M	hcg:	sets{[<DD/MM/YYYY>+";"+ <HH:MM:SS>+";"+ <parameter data> | E_NOT_FOUND]}sets	The returned parameter data may span more than one message frame, if this is the case fields should not be split across frames. A new response frame will be started for each new parameter data record. Note that 'sets' is interpreted as follows: sets = 50 for E_CONFIG sets = 50 for E_SYRINGE sets = 100 for E_GRASEBY Note that E_NOT_FOUND will be returned for any empty data sets.
Read infusion list	Retrieves a list of infusion histories found between the dates specified.	M	HLI:	<DD/MM/YYYY>+";"+ <DD/MM/YYYY>	M	hli:	Frame 1: E_OK+";"+ VN | E_NOT_FOUND | E_NOTOK] Frame 2: 1{<event data>}3000	where VN is the primary software version in the form (N)+N+"."+N **Note**: An infusion is characterised by infusion start and stop events, there may be a number of events (e.g. rate change) between these events. A stop event is an event that requires the infusion to be set-up again before a start event (key press or external command) is accepted. **Note**: The event number, date and time are for the start event of each infusion found. <event number> is a record sequence number from the history store.

Command Name	Description	Transmitted Data			Response Data			Notes
		Control	Command	Parameters	Control	Command	Parameters	
Read totalisers	Read the user totaliser value from the pump.	M	TG:	None	M	tg:	**For continuous, intermittent etc.**: <reset date>+";"+ <reset time>+";"+ <volume total>+";"+ <mass total> **For PCA and PCS:** <reset date>+";"+ <reset time>+";"+ <volume total>+";"+ <mass total>+";"+ <total demands>+";"+ <total good demands>	Note that the response is different for different infusion modes. The values returned correspond to those available to a user of the pump at the front panel.
Reset totaliser enable	First of 2 commands that must be sent in order to reset the user totaliser.	C	TRE:	None	C	tre:	[E_OK | E_NOTOK]	
Reset totaliser confirm	Second of 2 commands that must be sent in order to reset the user totaliser.	C	TRC:	None	C	trc:	[E_OK | E_NOTOK]	This command must be sent within 2 seconds of the reset totalisers enable command. The response will not be transmitted (from the pump) until the totalisers are reset.

Configuration Commands

The pump will only accept these commands in Configuration State.

Note that changes to Pump Configuration parameters will reset programming parameters to default values.

In the following a single letter response may be received which has the following meaning:

U - unavailable/not installed
D - Disabled
E - enabled
Y - Yes
N - No

Command Name	Description	Transmitted Data			Response Data			Notes
		Control	Command	Parameters	Control	Command	Parameters	
Key beep enabled	Reads the value of the 'Key beep' configuration parameter.	M	CKB:	None	M	ckb:	["Y" | "N"]	
Set key beep	Sets the value of the 'Key beep' configuration parameter.	C	CKB:=	["Y" | "N"]	C	ckb:=	[E_OK+";"+<value as set> | E_NOTOK]	
Lock cover security	Reads the value of the 'Lockable cover' configuration parameter.	M	LCS:	None	M	lcs:	["U" | "E" | "D"]	Value "Enabled" corresponds to 'With security; value "Disabled" corresponds to "Without security".
Set lock cover security	Sets the value of the 'Lockable cover' configuration parameter.	C	LCS:=	["E" | "D"]	C	lcs:=	[E_OK+";"+<value as set> | E_NOTOK]	Value "Enabled" corresponds to 'With security; value "Disabled" corresponds to "Without security".
Intermittent mode status	Reads the value of the 'Intermittent mode' configuration parameter.	M	CIM:	None	M	cim:	["U" | "E" | "D"]	

Command Name	Description	Transmitted Data			Response Data			Notes
		Control	Command	Parameters	Control	Command	Parameters	
Set intermittent mode	Sets the value of the 'Intermittent mode' configuration parameter.	C	CIM:=	["E" | "D"]	C	cim:=	[E_OK+";"+<value as set> | E_NOTOK]	
Pre-set volume mode status	Reads the value of the 'Pre-Set volume mode' configuration parameter.	M	CPV:	None	M	cpv:	["U" | "E" | "D"]	
Set pre-set volume mode	Sets the value of the 'Pre-Set volume mode' configuration parameter.	C	CPV:=	["E" | "D"]	C	cpv:=	[E_OK+";"+<value as set> | E_NOTOK]	
Pre-set time mode status	Reads the value of the 'Pre-Set time mode' configuration parameter.	M	CPT:	None	M	cpt:	["U" | "E" | "D"]	
Set pre-set time mode	Sets the value of the 'Pre-Set time mode' configuration parameter.	C	CPT:=	["E" | "D"]	C	cpt:=	[E_OK+";"+<value as set> | E_NOTOK]	
Circadian mode status	Reads the value of the 'Circadian rhythm' configuration parameter	M	CCR:	None	M	ccr:	["U" | "E" | "D"]	
Set circadian mode	Sets the value of the 'Circadian rhythm' configuration parameter.	C	CCR:=	["E" | "D"]	C	ccr:=	[E_OK+";"+<value as set> | E_NOTOK]	
ml/min infusion status	Reads the value of the 'Infusion in ml/min' configuration parameter.	M	CMM:	None	M	cmm:	["E" | "D"]	
Set ml/min infusion mode	Sets the value of the 'Infusion in ml/min' configuration parameter.	C	CMM:=	["E" | "D"]	C	cmm:=	[E_OK+";"+<value as set> | E_NOTOK]	
Mass units 1 status	Reads the value of the 'Infusion in mg/kg/h' configuration parameter.	M	MUA:	None	M	mua:	["U" | "E" | "D"]	

Command Name	Description	Transmitted Data			Response Data			Notes
		Control	Command	Parameters	Control	Command	Parameters	
Set mass units 1	Sets the value of the 'Infusion in mg/kg/h' configuration parameter.	C	MUA:=	["E" | "D"]	C	mua:=	[E_OK+";"+<value as set> | E_NOTOK]	
Mass units 2 status	Reads the value of the 'Infusion in mg/kg/min' configuration parameter.	M	MUB:	None	M	mub:	["U" | "E" | "D"]	
Set mass units 2	Sets the value of the 'Infusion in mg/kg/min' configuration parameter.	C	MUB:=	["E" | "D"]	C	mub:=	[E_OK+";"+<value as set> | E_NOTOK]	
Mass units 3 status	Reads the value of the 'Infusion in µg/kg/h' configuration parameter.	M	MUC:	None	M	muc:	["U" | "E" | "D"]	
Set mass units 3	Sets the value of the 'Infusion in µg/kg/h' configuration parameter.	C	MUC:=	["E" | "D"]	C	muc:=	[E_OK+";"+<value as set> | E_NOTOK]	
Mass units 4 status	Reads the value of the 'Infusion in µg/kg/min' configuration parameter.	M	MUD:	None	M	mud:	["U" | "E" | "D"]	
Set mass units 4	Sets the value of the 'Infusion in µg/kg/min' configuration parameter.	C	MUD:=	["E" | "D"]	C	mud:=	[E_OK+";"+<value as set> | E_NOTOK]	
Mass units 5 status	Reads the value of the 'Infusion in mg/h' configuration parameter.	M	MUE:	None	M	mue:	["U" | "E" | "D"]	
Set mass units 5	Sets the value of the 'Infusion in mg/h' configuration parameter.	C	MUE:=	["E" | "D"]	C	mue:=	[E_OK+";"+<value as set> | E_NOTOK]	
Mass units 6 status	Reads the value of the 'Infusion in mg/min' configuration parameter	M	MUF:	None	M	muf:	["U" | "E" | "D"]	
Set mass units 6	Sets the value of the 'Infusion in mg/min' configuration parameter.	C	MUF:=	["E" | "D"]	C	muf:=	[E_OK+";"+<value as set> | E_NOTOK]	

Com-mand Name	Description	Transmitted Data			Response Data			Notes
		Con-trol	Com-mand	Parameters	Con-trol	Com-mand	Parameters	
Mass units 7 status	Reads the value of the 'Infusion in µg/h' configuration parameter.	M	MUG:	None	M	mug:	["U" | "E" | "D"]	
Set mass units 7	Sets the value of the 'Infusion in µg/h' configuration parameter.	C	MUG:=	["E" | "D"]	C	mug:=	[E_OK+";"+<value as set> | E_NOTOK]	
Mass units 8 status	Reads the value of the 'Infusion in µg/min' configuration parameter.	M	MUH:	None	M	muh:	["U" | "E" | "D"]	
Set mass units 8	Sets the value of the 'Infusion in µg/min' configuration parameter.	C	MUH:=	["E" | "D"]	C	muh:=	[E_OK+";"+<value as set> | E_NOTOK]	
Mass units 9 status	Reads the value of the 'Infusion in ng/kg/h' configuration parameter.	M	MUI:	None	M	mui:	["U" | "E" | "D"]	Nanogram / kg/h
Set mass units 9 status	Sets the value of the 'Infusion in ng/kg/h' configuration parameter.	C	MUI:=	["E" | "D"]	C	mui:=	[E_OK+";"+<value as set> | E_NOTOK]	
Mass units 10 status	Reads the value of the 'Infusion in ng/kg/min' configuration parameter.	M	MUJ:	None	M	muj:	["U" | "E" | "D"]	Nanogram / kg/min
Set mass units 10 status	Sets the value of the 'Infusion in ng/kg/min' configuration parameter.	C	MUJ:=	["E" | "D"]	C	muj:=	[E_OK+";"+<value as set> | E_NOTOK]	
Mass units 11 status	Reads the value of the 'Infusion in ng/h' configuration parameter.	M	MUK:	None	M	muk:	["U" | "E" | "D"]	Nanogram / h
Set mass units 11 status	Sets the value of the 'Infusion in ng/h' configuration parameter.	C	MUK:=	["E" | "D"]	C	muk:=	[E_OK+";"+<value as set> | E_NOTOK]	
Mass units 12 status	Reads the value of the 'Infusion in ng/min' configuration parameter.	M	MUL:	None	M	mul:	["U" | "E" | "D"]	Nanogram /min

Command Name	Description	Transmitted Data			Response Data			Notes
		Control	Command	Parameters	Control	Command	Parameters	
Set mass units 12 status	Sets the value of the 'Infusion in ng/min' configuration parameter.	C	MUL:=	["E" | "D"]	C	mul:=	[E_OK+";"+<value as set> | E_NOTOK]	
Maximum purge rate	Reads the value of the 'Purge rate' configuration parameter.	M	MPR:	None	M	mpr:	["0" | "50" | "100" | "200" | "400" | "800"]	
Set maximum purge rate	Sets the value of the 'Purge rate' configuration parameter.	C	MPR:=	["0" | "50" | "100" | "200" | "400" | "800"]	C	mpr:=	[E_OK+";"+<value as set> | E_NOTOK]	
Rate change while running	Reads the value of the 'Rate change while running' configuration parameter.	M	RCR:	None	M	rcr:	["E" | "D"]	
Set rate change while running	Sets the value of the 'Rate change while running' configuration parameter.	C	RCR:=	["E" | "D"]	C	rcr:=	[E_OK+";"+<value as set> | E_NOTOK]	
Read alarm tone	Reads the value of the 'Operating Alarm sound' configuration parameter.	M	AL:	None	M	al:	["1" | "2" | "3" | "4" | "5"]	
Set Alarm tone	Sets the value of the 'Operating Alarm sound' configuration parameter.	C	AL:=	["1" | "2" | "3" | "4" | "5"]	C	al:=	[E_OK+";"+<value as set> | E_NOTOK]	
Get Bolus beep	Reads the value of the 'Bolus beep' configuration parameter	M	BBP:	None	M	bbp:	["Y" | "N"]	
Set Bolus beep	Sets the value of the 'Bolus beep' configuration parameter	C	BBP:=	["Y" | "N"]	C	bbp:=	[E_OK+";"+<value as set> | E_NOTOK]	
Get Preset bolus enable	Reads the value of the 'Bolus preset' configuration parameter.	M	PBL:	None	M	pbl:	["U" | "E" | "D"]	

Command Name	Description	Transmitted Data			Response Data			Notes
		Control	Command	Parameters	Control	Command	Parameters	
Set Preset bolus enable	Sets the value of the 'Bolus preset' configuration parameter.	C	PBL:=	["E" | "D"]	C	pbl:=	[E_OK+";"+<value as set> | E_NOTOK]	
Read LCD flash on alarm	Reads the value of the 'Red LCD flash on alarm' configuration parameter.	M	RAL:	None	M	ral:	["Y" | "N"]	
Set LCD flash on alarm	Sets the value of the 'Red LCD flash on alarm' configuration parameter.	C	RAL:=	["Y" | "N"]	C	ral:=	[E_OK+";"+<value as set> | E_NOTOK]	
Get drug concent-ration entry	Reads the value of the 'Drug concentration entry' configuration parameter.	M	DCE:	None	M	dce:	[E_USER | E_PRE| E_NOT_AVAILABLE]	
Set drug concentrat ion entry	Sets the value of the 'Drug concentration entry' configuration parameter.	C	DCE:=	[E_USER | E_PRE]	C	dce:=	[E_OK+";"+<value as set> | E_NOTOK]	
Read In-line occlusion sensing	Reads the value of the 'In-line pressure sensing' configuration parameter.	M	ILS:	None	M	ils:	["U" | "E" | "D"]	
Set Inline occlusion sensing	Sets the value of the 'In-line pressure sensing' configuration parameter.	C	ILS:=	["E" | "D"]	C	ils:=	[E_OK+";"+<value as set> | E_NOTOK]	
Read start delay	Reads the value of the 'Intermittent mode start delay' configuration parameter.	M	IST:	None	M	ist:	["U" | "E" | "D"]	
Set start delay	Sets the value of the 'Intermittent mode start delay' configuration parameter.	C	IST:=	["E" | "D"]	C	ist:=	[E_OK+";"+<value as set> | E_NOTOK]	

Command Name	Description	Transmitted Data			Response Data			Notes
		Control	Command	Parameters	Control	Command	Parameters	
Read max rate	Reads the value of the 'Maximum infusion rate' configuration parameter.	M	MXR:	None	M	mxr:	["50" | "100" | "200" | "400" | "800"]	
Set max rate	Sets the value of the 'Maximum flow rate' configuration parameter.	C	MXR:=	["50" | "100" | "200" | "400" | "800" |]	C	mxr:=	[E_OK+";"+<value as set> | E_NOTOK]	
Read max bolus rate	Reads the value of the 'Maximum bolus rate' configuration parameter.	M	MXB:	None	M	mxb:	["50" | "100" | "200" | "400" | "800"]	
Set max bolus rate	Sets the value of the 'Maximum bolus rate' configuration parameter.	C	MXB:=	["50" | "100" | "200" | "400" | "800" | "1200" | "1800"]	C	mxb:=	[E_OK+";"+<value as set> | E_NOTOK]	
Read Bolus enable	Reads the value of the 'Enable Bolus' configuration parameter.	M	ENB:	None	C	enb:	["U" | "E" | "D"]	
Set Bolus enable	Sets the value of the 'Enable Bolus' configuration parameter.	C	ENB:=	["E" | "D"]	M	enb:=	[E_OK+";"+<value as set> | E_NOTOK]	
Read Backlight On time	Reads the value of the 'Backlight on time following key press' configuration parameter.	M	BON:	None	M	bon:	["0.5" | "1.5" | "2" | "2.5" | "3"]	Value is in minutes.
Set Backlight On time	Sets the value of the 'Backlight on time following key press' configuration parameter.	C	BON:=	["0.5" | "1.5" | "2" | "2.5" | "3"]	C	bon:=	[E_OK+";"+<value as set> | E_NOTOK]	
Read Remote control enable	Reads the value of the 'External Control' configuration parameter.	M	RCE:	None	M	rce:	["U" | "E" | "D"]	
Set remote control enable	Sets the value of the 'External Control' configuration parameter.	C	RCE:=	["E" | "D"]	M	rce:=	[E_OK+";"+<value as set> | E_NOTOK]	

Command Name	Description	Transmitted Data			Response Data			Notes
		Control	Command	Parameters	Control	Command	Parameters	
Read configuration password	Read configuration password governing entry into Configuration state.	M	CPSS:	None	M	cpss:	5{<character>}5	Where <character> is one of {0,1,2,3,4,5,6,7,8,9,'.'}.
Read Clinician password	Read Clinician password governing Clinician Override.	M	CLPS:	None	M	clps:	5{<character>}5	Where <character> is one of {0,1,2,3,4,5,6,7,8,9,'.'}.
Set Clinician password	Set Clinician password governing Clinician Override.	C	CLPS:=	5{<character>}5	C	clps:=	[E_OK;<value set> | E_NOTOK]	Where <character> is one of {0,1,2,3,4,5,6,7,8,9,'.'}.
Read KVO rate	Reads the KVO rate set-up in the pump.	M	KVO:	None	M	kvo:	<<KVO rate>>	A returned value of 0 indicates that KVO is disabled.
Set the KVO rate	Sets the KVO rate to be used by the pump.	C	KVO:=	<<KVO rate>>	C	kvo:=	[E_OK+";"+<<KVO rate set>> | E_RANGE_ERR+";"+E_LT+ ";"+ <KVO rate lower limit> | E_RANGE_ERR+";"+E_GT+ ";"+ <KVO rate upper limit>]	A value of zero is valid, but falls outside of the standard range against which all non-zero KVO rate values should be checked.
Read near empty type	Reads the near empty type currently set.	M	NET:	None	M	net:	[E_TIME | E_VOLUME]	This specifies volume or time based mode for the near empty system.
Set the near empty type	Set the near empty type to be used by the pump.	C	NET:=	[E_TIME | E_VOLUME]	C	net:=	[E_OK+";"+<value as set> | E_NOTOK]	

Command Name	Description	Transmitted Data			Response Data			Notes
		Control	Command	Parameters	Control	Command	Parameters	
Read near empty point	Reads the current near empty point set.	M	NEP:	None	M	nep:	[“1” | “2” | “3” | “5” | “10”] | [“0.2” | “0.5” | “1” | “2” | “3” | “5” | “10” | “AUTO”]	The value returned is affected by the mode in use for the near empty system, so to interpret the value the mode must have been determined by the external controller prior to this command being used.
Set near empty point	Sets the near empty point for the near empty system currently selected.	C	NEP:=	[“1” | “2” | “3” | “5” | “10”] | [“0.2” | “0.5” | “1” | “2” | “3” | “5” | “10” | “AUTO”]	C	nep:=	[E_OK+“;”+<value as set> | E_RANGE_ERR]	The response E_RANGE_ERR will be returned if the value sent is not in the set of permitted values for the current near empty type.
Read key beep volume	Reads the current setting for the keep beep volume.	M	KBV:	None	M	kbv:	[E_OK+”;”+<0 to 10> | E_NOTOK]	Note a returned value of 0 indicates that the key beep is off. E_NOTOK will be used to indicate that the command could not be processed because the parameter is unavailable through higher-level configuration settings.
Set key beep volume	Sets the key beep volume to the value passed.	C	KBV:=	<0 to 10>	C	kbv:=	[E_OK+“;”+<value as set> | E_RANGE_ERR+”;”+E_LT+”;”+<key beep volume lower limit> | E_RANGE_ERR+”;”+E_GT+”;”+<key beep volume upper limit> | E_NOTOK]	E_NOTOK will be used to indicate that the command could not be processed because the parameter is unavailable through higher-level configuration settings.
Read display contrast	Reads the current setting for the display contrast.	M	DCO:	None	M	dco:	<0 to 20>	The value returned will be in the range 0 (low) to 20 (high).

Command Name	Description	Transmitted Data			Response Data			Notes
		Control	Command	Parameters	Control	Command	Parameters	
Set display contrast	Sets the display contrast to the value passed.	C	DCO:=	<0 to 20>	C	dco:=	[E_OK+";"+<value as set> | E_RANGE_ERR+";"+E_LT+ ";"+ <display contrast lower limit> | E_RANGE_ERR+";"+E_GT+ ";"+ <display contrast upper limit>]	
Read display brightness	Reads the current setting for the display backlight brightness.	M	DBI:	None	M	dbi:	<0 to 20>	The value returned will be in the range 0 (off), 1 (dim) to 20 (bright).
Set display brightness	Sets the display backlight brightness to the value passed.	C	DBI:=	<0 to 20>	C	dbi:=	[E_OK+";"+<value as set> | E_RANGE_ERR+";"+E_LT+ ";"+ <display brightness lower limit> | E_RANGE_ERR+";"+E_GT+ ";"+ <display brightness upper limit>]	When the pump is on battery it can override the display brightness setting, using a reduced level. Valid values passed with this command should be accepted, even if the pump is currently overriding display brightness to a lower level.
Read default bolus rate	Reads the default bolus rate as set by the user.	M	MBR:	None	M	mbr:	<<Bolus rate (ml/h)>>	The Bolus rate is returned in ml/h only.
Set default bolus rate	Sets the default bolus rate.	C	MBR:=	<<Bolus rate (ml/h)>>	C	mbr:=	[E_OK+";"+<<Bolus rate (ml/h) set>> | E_RANGE_ERR+";"+E_LT+ ";"+ <Bolus rate lower limit> | E_RANGE_ERR+";"+E_GT+ ";"+ <Bolus rate upper limit>]	The Bolus rate is set in ml/h only. This value is accepted with no reference to the size of syringe loaded.

Command Name	Description	Transmitted Data			Response Data			Notes
		Control	Command	Parameters	Control	Command	Parameters	
Read double press value	Read the value of the double press for demand set.	M	DPS:	None	M	dps:	[E_YES | E_NO]	
Set double press value	Set the value of the double press for demand.	C	DPS:=	[E_YES | E_NO]	C	dps:=	[E_OK+";"+<value as set> | E_NOTOK]	
Read time to nurse call back alarm	Read the time to nurse call back alarm set.	M	NCB:	None	M	ncb:	["0.5" | "1" | "2" | "3" | "4" | "5"]	Value represents minutes.
Set time to nurse callback alarm	Set the time to nurse call back alarm.	C	NCB:=	["0.5" | "1" | "2" |"3" | "4" | "5"]	C	ncb:=	[E_OK+";"+<value as set> | E_NOTOK]	Value represents minutes.
Read PCA/ PCS loading dose	Reads the value of the 'PCA/ PCS loading dose' configuration parameter.	M	ALD:	None	M	ald:	["U" | "E"]	Indicates if a loading dose is required as part of programming sequence.
Set PCA/ PCS loading dose	Sets the value of the 'PCA/ PCS loading dose' configuration parameter.	C	ALD:=	["E" | "D"]	C	ald:=	[E_OK+";"+<value as set> | E_NOTOK]	Set to" E " if a loading dose is required as part of programming sequence.

Command Name	Description	Transmitted Data			Response Data			Notes
		Control	Command	Parameters	Control	Command	Parameters	

Read PCA/ PCS dose limit enable	Reads the value of the 'PCA/ PCS dose limit enable' configuration parameter.	M	ADL:	None	M	adl:	[NO_DOSE_LIMIT | DEMANDS| MASS_OR_VULUME]	Indicates if a dose limit is required as part of programming sequence.
								Enum
								{
								NO_DOSE_LIMIT = 0,
								DEMANDS = 1,
								MASS_OR_VULUME = 2,
								}

Set PCA/ PCS dose limit enable	Sets the value of the 'PCA/ PCS dose limit enable' configuration parameter.	C	ADL:=	[NO_DOSE_LIMIT | DEMANDS| MASS_OR_VULUME]	C	adl:=	[E_OK+";"+<value as set> | E_NOTOK]	

Command Name	Description	Transmitted Data			Response Data			Notes
		Control	Command	Parameters	Control	Command	Parameters	

Read PCA/ PCS dose limit fixed period	Reads the value of the 'PCA/ PCS dose limit fixed period' configuration parameter.	M	ADLP:	None	M	adlp:	[INFUSION | ONE_HOUR | TWO_HOURS | THREE_HOURS | FOUR_HOURS | FIVE_HOURS | SIX_HOURS | SEVEN_HOURS | EIGHT_HOURS | USER_DEFINE]	Indicates the period over which the dose limit is calculated.
								Enum
								{
								INFUSION = 0,
								ONE_HOUR = 1,
								TWO_HOURS =2,
								THREE_HOURS=3,
								FOUR_HOURS=4,
								FIVE_HOURS=5
								SIX_HOURS = 6,
								SEVEN_HOURS = 7,
								EIGHT_HOURS = 8,
								USER_DEFINE = 9,
								}

Set PCA/ PCS dose limit fixed period	Sets the value of the 'PCA/ PCS dose limit fixed period' configuration parameter.	C	ADLP:=	[INFUSION | ONE_HOUR | TWO_HOURS | THREE_HOURS | FOUR_HOURS | FIVE_HOURS | SIX_HOURS | SEVEN_HOURS | EIGHT_HOURS | USER_DEFINE]	C	adlp:=	[INFUSION | ONE_HOUR | TWO_HOURS | THREE_HOURS | FOUR_HOURS | FIVE_HOURS | SIX_HOURS | SEVEN_HOURS | EIGHT_HOURS | USER_DEFINE]	

Command Name	Description	Transmitted Data			Response Data			Notes
		Control	Command	Parameters	Control	Command	Parameters	
Read PCA/ PCS continuous infusion	Reads the value of the 'PCA/ PCS continuous infusion' configuration parameter.	M	ACI:	None	M	aci:	["U" | "E"]	Indicates if a continuous background infusion is required as part of programming sequence.
Set PCA/ PCS continuous infusion'	Sets the value of the 'PCA/ PCS continuous infusion' configuration parameter.	C	ACI:=	["E" | "D"]	C	aci:=	[E_OK+";"+<value as set> | E_NOTOK]	Set to" E " if a continuous background infusion is required as part of programming sequence
Read PCA/ PCS Clinician override	Reads the value of the 'PCA/ PCS Clinician Override bolus' configuration parameter.	M	ACO:	None	M	aco:	["U" | "E"]	Indicates if the Clinician override feature is available.
Set PCA/ PCS Clinician override	Sets the value of the 'PCA/ PCS Clinician Override bolus' configuration parameter.	C	ACO:=	["E" | "D"]	C	aco:=	[E_OK+";"+<value as set> | E_NOTOK]	Set to" E " if the Clinician override feature is active.
Read PCA/ PCS beep on bad	Reads the value of the 'PCA/ PCS beep on bad demands' configuration parameter.	M	ABD:	None	M	abd:	["Y" | "N"]	Defines if the pump should beep once in response to a bad demand.
Set PCA/ PCS beep on bad	Sets the value of the 'PCA/ PCS beep on bad demands' configuration parameter	C	ABD:=	["Y" | "N"]	C	abd:=	[E_OK+";"+<value as set> | E_NOTOK]	
Read PCA/ PCS user programming	Reads the value of the 'PCA/ PCS user programming' configuration parameter	M	AUP:	None	M	aup:	["E" | "D"]	Determines if user is allowed to program infusion by controlling PROGRAM INFUSION option in drug protocol screen.
Set PCA/ PCS user programming	Sets the value of the 'PCA/ PCS user programming' configuration parameter.	C	AUP:=	["E" | "D"]	M	aup:=	[E_OK+";"+<value as set> | E_NOTOK]	

Command Name	Description	Transmitted Data			Response Data			Notes
		Control	Command	Parameters	Control	Command	Parameters	
Read PCA/ PCS beep on good	Reads the value of the 'PCA/ PCS beep on good demands' configuration parameter.	M	ABGD:	None	M	abgd:	["Y" | "N"]	Defines if the pump should beep once in response to a good demand.
Set PCA/ PCS beep on good	Sets the value of the 'PCA/ PCS beep on good demands' configuration parameter.	C	ABGD: =	["Y" | "N"]	C	abgd:=	[E_OK+";"+<value as set> | E_NOTOK]	
Read PCA/ PCS bad demand limit	Reads the value of the 'PCA/ PCS bad demands limit' configuration parameter.	M	ABLT:	None	M	ablt:	[0-50]	Defines the number of bad demands allowed before the alarm is triggered.
Set PCA/ PCS bad demand limit	Sets the value of the 'PCA/ PCS bad demands limit' configuration parameter.	C	ABLT: =	[0-50]	M	ablt:=	[E_OK+";"+<value as set> | E_NOTOK]	
Read PCA/ PCS bad demand alarm	Reads the value of the 'PCA/ PCS bad demands alarm' configuration parameter.	M	ABDA:	None	M	abda:	["E" | "D"]	Indicates if an alarm should be generated if an excessive number of bad demands is detected.
Set PCA/ PCS bad demand alarm	Sets the value of the 'PCA/ PCS bad demands alarm' configuration parameter.	C	ABDA: =	["E" | "D"]	C	abda:=	[E_OK+";"+<value as set> | E_NOTOK]	
Read PCA/ PCS Drug protocol	Reads the value of the 'PCA/ PCS Drug protocol' configuration parameter.	M	ADPC:	None	M	adpc:	["Y" | "N"]	"Y" indicates that the user will be required to specify a drug protocol.
Set PCA/ PCS Drug protocol	Sets the value of the 'PCA/ PCS Drug protocol' configuration parameter.	C	ADPC:=	["Y" | "N"]	C	adpc:=	[E_OK+";"+<value as set> | E_NOTOK]	
Read PCA/ PCS Occlusion lock level	Read the value of the 'PCA/ PCS Occlusion lock level' configuration parameter.	M	AOCL:	None	M	aocl:	["0" | "1" | "2" | "3" | "4" | "5"]	Defines if user is allowed to adjust the dry side occlusion level.

Command Name	Description	Transmitted Data			Response Data			Notes
		Control	Command	Parameters	Control	Command	Parameters	
Set PCA/ PCS Occlusion lock level	Set the value of the 'PCA/PCS Occlusion lock level' configuration parameter.	C	AOCL:=	["0" | "1" | "2" |"3" | "4" | "5"]	C	aocl:=	[E_OK+";"+<value as set> | E_NOTOK]	If set to "0" the user can select any occlusion level. If set to a level ("1" to "5") then user can only select up to and including the set level.
Read PCA/ PCS Double Press	Reads the value of the 'PCA/ PCS Double Press' configuration parameter.	M	ADPR:	None	M	adpr:	["E" | "D"]	
Set PCA/ PCS Double Press	Sets the value of the 'PCA/ PCS Double Press ' configuration parameter.	C	ADPR:=	["E" | "D"]	C	adpr:=	[E_OK+";"+<value as set> | E_NOTOK]	Defines whether or not a double press of the PCA handset is required to trigger a PCA dose.
Read PCA/ PCS Bolus available LED	Reads the value of the 'PCA/ PCS Bolus available LED' configuration parameter.	M	ABAL:	None	M	abal:	[E_LED_OFF | E_LED_CONTINUOUS | E_LED_AVAILABLE]	
Set PCA/ PCS Bolus available LED	Sets the value of the 'PCA/ PCS Bolus available LED' configuration parameter.	C	ABAL:=	[E_LED_OFF | E_LED_CONTINUOUS | E_LED_AVAILABLE]	C	abal:=	[E_OK+";"+<value as set> | E_NOTOK]	If set to E_ LED_OFF then LED in handset is off. If set to E_LED_CONTINUOUS then LED in handset is continuously illuminated. If set to E_ LED_AVAILABLE then LED in handset will light when patient can request a bolus dose..
Read PCA/ PCS Dose duration Mode	Reads the value of the 'PCA/ PCS Dose duration Mode' configuration parameter.	M	ADDM:	None	M	addm:	[E_STAT | E_USER_RATE]	

Command Name	Description	Transmitted Data			Response Data			Notes
		Control	Command	Parameters	Control	Command	Parameters	
Set PCA/ PCS Dose duration Mode	Sets the value of the 'PCA/ PCS Dose duration Mode' configuration parameter.	C	ADDM:=	[E_STAT | E_USER_RATE]	C	addm:=	[E_OK+";"+<value as set> | E_NOTOK]	If set to E_SAT then Pump runs at maximum rate and deduces the time from this. If set to E_USER_RATE then user defines the time and Pump deduces the time from this.
Read PCA/ PCS Clinician Override.	Reads the value of the 'PCA/ PCS Clinician override' configuration parameter.	C	ACO:	None	M	aco:	["E" | "D"]	
Set PCA/ PCS Clinician Override.	Sets the value of the 'PCA/ PCS Clinician override' configuration parameter.	M	ACO:=	["E" | "D"]	C	aco:=	[E_OK+";"+<value as set> | E_NOTOK]	Indicates if Clinician Override feature is available.
Read PCA/ PCS Charting pain mode.	Reads the value of the 'PCA/ PCS Charting pain' configuration parameter.	M	APSM:	None	M	apsm:	[E_PAIN_SCORE_DISABLED | E_PAIN_SCORE_SEPARATE | E_PAIN_SCORE_COMBINED]	
Set PCA/ PCS Charting pain mode.	Sets the value of the 'PCA/ PCS Charting pain' configuration parameter.	C	APSM:=	[E_PAIN_SCORE_DISABLED | E_PAIN_SCORE_SEPARATE | E_PAIN_SCORE_COMBINED]	C	apsm:=	[E_OK+";"+<value as set> | E_NOTOK]	Indicates if pain score is disabled, separate or combined.
Read PCA/ PCS Score range pain.	Reads the value of the 'PCA/ PCS Score range pain' configuration parameter.	M	ASRP:	None	M	asrp:	[E_SCORE_RANGE_0_TO_3 | E_SCORE_RANGE_0_TO_10 | E_SCORE_RANGE_0_TO_100]	

Com-mand Name	Description	Transmitted Data			Response Data			Notes
		Con-trol	Com-mand	Parameters	Con-trol	Com-mand	Parameters	
Set PCA/ PCS Score range pain.	Sets the value of the 'PCA/ PCS Score range pain' configuration parameter.	C	ASRP:=	[E_SCORE_RANGE_0_TO_3 | E_SCORE_RANGE_0_TO_10 | E_SCORE_RANGE_0_TO_100]		asrp:=	[E_OK+";"+<value as set> | E_NOTOK]	Determines if pain score charting uses a scoring scale of 0 – 3 ; 0 – 10; or 0 –100.
Read PCA/ PCS Score range nausea sedation.	Reads the value of the 'PCA/ PCS Score range nausea sedation' configuration parameter.	M	ASRN:	None	M	asrn:	[E_SCORE_RANGE_0_TO_3 | E_SCORE_RANGE_0_TO_10 | E_SCORE_RANGE_0_TO_100]	
Set Read PCA/PCS Score range nausea sedation.	Sets Reads the value of the 'PCA/PCS Score range nausea sedation' configuration parameter.	C	ASRN:=	[E_SCORE_RANGE_0_TO_3 | E_SCORE_RANGE_0_TO_10 | E_SCORE_RANGE_0_TO_100]		asrn:=	[E_OK+";"+<value as set> | E_NOTOK]	Determines if nausea and sedation score charting uses a scoring scale of 0 – 3 ; 0 – 10; or 0 –100.
Read PCA/ PCS Charting nausea.	Reads the value of the 'PCA/ PCS Charting nausea' configuration parameter.	M	ACHN:	None	M	achn:	["E" | "D"]	
Set PCA/ PCS Charting nausea.	Sets the value of the 'PCA/ PCS Charting nausea' configuration parameter.	C	ACHN: =	["E" | "D"]	C	achn:=	[E_OK+";"+<value as set> | E_NOTOK]	Indicates if a charting for nausea is available.
Read PCA/ PCS Charting sedation.	Reads the value of the 'PCA/ PCS Charting sedation' configuration parameter.	M	ACHS:	None	M	achs:	["E" | "D"]	

Command Name	Description	Transmitted Data			Response Data			Notes
		Control	Command	Parameters	Control	Command	Parameters	
Set PCA/ PCS Charting sedation.	Sets the value of the 'PCA/ PCS Charting sedation' configuration parameter.	C	ACHS:=	["E" | "D"]	C	achs:=	[E_OK+";"+<value as set> | E_NOTOK]	Indicates if a charting for sedation is available.
Read PCA/ PCS Shift totals.	Reads the value of the 'PCA/ PCS Shift totals' configuration parameter.	M	ASTO:	None	M	asto:	["E" | "D"]	
Set PCA/ PCS Shift totals.	Sets the value of the 'PCA/ PCS Shift totals' configuration parameter.	C	ASTO:=	["E" | "D"]	C	asto:=	[E_OK+";"+<value as set> | E_NOTOK]	Indicates if shift totals feature is availble.
Read PCA/ PCS Shift times.	Reads the value of the 'PCA/ PCS Shift times' configuration parameter	M	ASTM:	None	M	astm:	[<value (shift1)> + ";" [<value (shift2)> +";" [<value (shift3)>	
Set PCA/ PCS Shift times.	Sets the value of the 'PCA/ PCS Shift times' configuration parameter.	C	ASTM:=	[<value (shift1)> + ";" [<value (shift2)> +";" [<value (shift3)>	C	astm:=	[E_OK+";"+<value as set> | E_NOTOK]	Defines the start times of up to 3 shifts. Where <shift> = <HH:MM>
Read wait mode.	Reads the value of the 'wait mode ' configuration parameter.	M	AWM:	None	M	awm:	["E" | "D"]	
Set wait mode.	Sets the value of the 'wait mode ' configuration parameter.	C	AWM:=	["E" | "D"]	C	awm:=	[E_OK+";"+<value as set> | E_NOTOK]	Indicates if the WAIT (SLEEP) mode is available.
Read Inline Cap value	Reads the value of the "Inline pressure limit" configuration parameter.	M	ILL:	None	M	ill:	[0-999]	
Set Inline Cap value	Sets the value of the "Inline pressure limit" configuration parameter.	C	ILL:=	[0-999]	C	ill:=	[E_OK+";"+<value as set> | E_NOTOK]	

Technician Commands

Note that the pump must be in the Technician State to accept these commands.

Com-mand Name	Description	Transmitted Data			Response Data			Notes
		Con trol	Com-mand	Parameters	Con trol	Com-mand	Parameters	
Read Total volume infused	Read 'total volume infused' Technician parameter.	M	TVOL:	None	M	tvol:	<0 to 9999999>	The value represents the total volume in ml of drug infused since manufacture of the pump. The response parameter defines the format of the returned data.
Read battery voltage	Read 'Battery voltage' Technician parameter	M	BT:	None	M	bt:	[E_OK+";"+<0.00 to 9.99> | E_NOTOK]	The value represents the main battery voltage (in volts). The response parameter defines the format of the returned data.
Read battery usage	Read 'Battery usage' Technician parameter.	M	BTU:	None	M	btu:	<0 to 99999>+";"+ <0 to 99999>+";"+ <0 to 99999>+";"+ <0 to 99999>	The four response parameters (i.e. battery ìbucketsî of <1hr, 1hr to 4hrs, 4hrs to 10hrs and =10hrs respectively) define the format of the returned data.
Read RTC	Read the current value of the Real Time Clock	M	CK:	None	M	ck:	<DD/MM/YYYY>+";"+ <HH:MM:SS>	
Set RTC	Sets the Real Time Clock to the passed value	C	CK:=	<DD/MM/ YYYY>+";"+ <HH:MM>	C	ck:=	[E_OK+";"+<DD/MM/ YYYY>+";"+ <HH:MM> | E_NOTOK]	Seconds are not included in the command. These are to be set to zero when the clock is updated.

Com-mand Name	Description	Transmitted Data			Response Data			Notes
		Con trol	Com-mand	Parameters	Con trol	Com-mand	Parameters	
Read service recall	Read ‘service recall period’ Technician parameter.	M	SVR:	None	M	svr:	<[“0” | “6” | “12”]>	
Set service recall	Set ‘service recall period’ Technician parameter.	C	SVR:=	<[“0” | “6” | “12”]>	C	svr:=	[E_OK+”;”+<[“0” | “6” | “12”]> | E_NOTOK]	
Read syringe dimensions	Read ’Custom syringe dimension’ Technician parameter.	M	SRG:	None	M	srg:	[E_OK+”;”\<CL>+”;”+ <BDO>+”;”+ <BDI>+”;”+ <NV>+”;”+ <NM> | “U”]	Where: CL closed length (hard height), <00.01to99.99> BDO outer barrel diameter, <00.01to99.99> BDI inner barrel diameter, <00.01to99.99> NV nominal volume [ì2î | ì2.5î | ì3î | ì5î | ì10î | ì20î | ì25î | ì30î | ì50î] NM name 12{<free text character>}12 The dimensions are in millimetres. A ìUî response indicates that there is not current setting for this parameter.

Com-mand Name	Description	Transmitted Data			Response Data			Notes
		Con trol	Com-mand	Parameters	Con trol	Com-mand	Parameters	
Set syringe dimensions	Set 'Custom syringe dimension' Technician parameter.	C	SRG:=	<CL>+";"+ <BDO>+";"+ <BDI>+";"+ <NV>+";"+ <NM>	C	srg:=	[E_OK+";"+ <CL>+";"î+ <BDO>+";"+ <BDI>+";"+ <NV>+";"+ <NM> | E_NOTOK]	Where: CL closed length (hard height), <00.01to99.99> BDO outer barrel diameter, <00.01to99.99> BDI inner barrel diameter, <00.01to99.99> NV nominal volume [ì2î | ì2.5î | ì3î | ì5î | ì10î | ì20î | ì25î | ì30î | ì50î] NM name 12{<free text character>}12 The dimensions are in millimetres.
Delete syringe	Delete the value for the 'Custom syringe dimension' Technician parameter.	C	DSRG:	None	C	dsrg:	[E_OK | E_NOTOK]	Removes the current setting for this parameter.
Read pump Id	Read 'Pump Id' Technician parameter.	M	PID:	None	M	pid:	20{<free text character>}20	
Set pump Id	Set 'Pump Id' Technician parameter.	C	PID:=	20{<free text character>}20	C	pid:=	[E_OK;<value set> | E_NOTOK]	
Read ward location	Read 'Ward location' Technician parameter.	M	WRD:	None	M	wrd:	20{<free text character>}20	

Com-mand Name	Description	Transmitted Data			Response Data			Notes
		Con trol	Com-mand	Parameters	Con trol	Com-mand	Parameters	
Set ward location	Set 'Ward location' Technician parameter.	C	WRD:=	20{<free text character>}20	C	wrd:=	[E_OK;<value set> | E_NOTOK]	
Read Tech passwor d	Read Technician password which governs entry into Technician state.	M	TPS:	None	M	tps:	5<character>5	Where <character> is one of {0,1,2,3,4,5,6,7,8,9,'.'}.
Store WSS Cal	Store the provided values, which are used to calibrate In-line sensor readings.	C	ILC:=	<A_0>+";"+<A_{sf},>+";"+ <P_{cal}>	C	ilc:=	[E_OK+";"\<A_{sf}, set>+";"+<P_{cal} set> | E_NOTOK]	<A_0> is <4480 to 25088>, a dimensionless value. <A_0> should be used as an initial offset calibration value.
Set display contrast	Sets the display contrast to the value passed.	C	DCO:=	<0 to 20>	C	dco:=	[E_OK+";"+<value as set> | E_RANGE_ERR+";"+E_LT+";"+ <display contrast lower limit> | E_RANGE_ERR+";"+E_GT+";"+ <display contrast upper limit>]	This command will be actioned but the value will not be saved to NV memory

Com-mand Name	Description	Transmitted Data			Response Data			Notes
		Con trol	Com-mand	Parameters	Con trol	Com-mand	Parameters	
Set display brightne ss	Sets the display backlight brightness to the value passed.	C	DBI:=	<0 to 20>	C	dbi:=	[E_OK+";"+<value as set> | E_RANGE_ERR+";"+E_L T+";"+ <display brightness lower limit> | E_RANGE_ERR+";"+E_G T+";"+ <display brightness upper limit>]	This command will be actioned but the value will not be saved to NV memory. When the pump is on battery it can override the display brightness setting, using a reduced level. Valid values passed with this command should be accepted, even if the pump is currently overriding display brightness to a lower level.
Read Date pump serviced	Reads the date of when the pump was recently served.	M	DPSD:	None	M	dpsd:	<DD/MM/YYYY>	Hours and Minutes are not included in the response.
Set Date pump serviced	Sets the date of when the pump was recently served.	C	DPSD: =	<DD/MM/YYYY>	C	dpsd:=	[E_OK+";"+<value as set> | E_NOTOK]	Hours and Minutes are not included in the command.
Read Service due message	Reads Service due message	M	SMSG:	None	M	smsg:	0{<free text character>}17 + ";" + 0{<free text character>}35+";" + 0{<free text character>}35 ";" + 0{<free text character>}35";" + 0{<free text character>}35	A title line of up to 17 characters + 4 lines of texts each up to 35 characters long.

Com-mand Name	Description	Transmitted Data			Response Data			Notes
		Con trol	Com-mand	Parameters	Con trol	Com-mand	Parameters	
Set Service due message	Sets Service due message	C	SMSG: =	0{<free text character>}17 +“;” + 0{<free text character>}35+ “;” + 0{<free text character>}35 “;” + 0{<free text character>}35 “;” + 0{<free text character>}35	C	smsg:=	[E_OK+“;”+<texts as set> | E_NOTOK]	A title line of up to 17 characters + 4 lines of texts each up to 35 characters long.
Read power up defaults	Reads power up defaults	M	PUDF:	None	M	pudf:	[“Y” |“N”]	Y = pump will use defaults after power up. N = pump will use the existing settings.
Set power up defaults	Sets power up defaults	C	PUDF: =	[“Y” | “N”]	C	pudf:=	[E_OK+“;”+ [“Y” | “N”] | E_NOTOK]	
Read Syringe brands enabled	Reads Syringe brands enabled	M	SYRB:	None	M	syrb:	[ìE” | “ìD”+“;”+ “Eî | “D”] + Ö “ì;” + “E”| “D”	A total of 16 (ìEî | ìDî)

Com-mand Name	Description	Transmitted Data			Response Data			Notes
		Con trol	Com-mand	Parameters	Con trol	Com-mand	Parameters	
Set Syringe brands enabled	Sets Syringe brands enabled	C	SYRB:=	[“E” | “D” + “;” + Ö “;” + “E” | “D”]	C	syrb:=	[E_OK+<values set> | E_NOTOK]	It is import to set the (E/D) for syringes according to the following order: BD PRECISE CODE EUROJECT EVANS FRESENIUS IMS PUMPJECT JMS MONOJECT NIPRO OMNIFIX PERFUSOR PHARMAJECT BD PLASTIPAK TERUMO TOP ZENECA PFS

The details given in this Manual are correct at the time of going to press. The company, however, reserves the right to improve the equipment shown.

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